# Digestion By Microorganisms In The Rumen

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WHEN careful consideration is given to the subject, it is amazing what a difference one substance, cellulose, can make in the anatomy and physiology of animals. Herbivora with their large stomachs, or ceca, and long intestinal tracts are well adapted for the digestion of cellulose. They can, however, exist on a carnivore-type diet, for they have all the necessary enzymes in their alimentary canal. This has been demonstrated conclusively by Trautmann[18] who kept rumenectomized goats alive for considerable periods by feeding them meat.

The large stomach compartments of the sheep and ox act as incubators for microorganisms. The organisms in turn convert cellulose into products that can be metabolized and absorbed. Digestion of cellulose has a two-fold purpose; it removes the protective coating from the outside of the cells so that the proteins and starches inside the cell may be available. Cellulose itself when broken down into fatty acids can be utilized for metabolism. Cellulose is most likely broken down to lactic acid in a manner similar to the way glycogen is hydrolyzed in mammals. Cellulose, like glycogen, is a long chain of glucose molecules. The difference between the two is in the manner in which the glucose molecules are connected to each other. The glycogen molecule consists of a large number of chains, each containing 12 to 18 glucose units. These chains are linked together to form a branched structure. Cellulose on the other hand consists of chains of glucose units linked together by B linkages.

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The microorganisms of the rumen are able to break the chemical linkages in cellulose and convert them into various fatty acids and gases. The breakdown to cellulose is probably as follows:

cellulose
↓
cellobiose
↓
glucose-1-phosphate
↓
glucose-6-phosphate
↓
fructose-6-phosphate
↓
fructose 1, 6 diphosphate
↓
glycerose-3-phosphate → dilydroxyacetone phosphate
↓
phosphoglycerate
↓
phosphopyruvate
↓
pyruvic acid
↓
lactic acid
↓
propionic acid
↓
acetic acid

The most important fatty acid formed in the breakdown of cellulose is acetic acid. Other acids formed during cellulose digestion are butyric, isobutyric, valerianic, propionic, formic, and succinic. These last mentioned acids are absorbed much more slowly from the rumen than acetic acid and are of much less

importance in metabolism.

During the decomposition of food in the rumen, there is the formation of considerable quantities of gases. Some of these, such as methane and carbon dioxide are most likely formed during the digestion of carbohydrates. Other gases such as nitrogen and oxygen probably diffuse into the rumen from the blood stream. Hydrogen sulfide may be formed by the bacterial decomposition of sulfur containing amino acids. The usual composition of rumen gases is given in the following table:

TABLE I. Analysis of Rumen Gases[5] (%)

| | | | |
|---|---|---|---|
| Carbon dioxide | 67 | Hydrogen sulfide | 0.1 |
| Methane | 26 | Oxygen | trace |
| Nitrogen | 6 | | |

Besides the digestion of cellulose, the microorganisms of the rumen synthesize large numbers of useful products such as amino acids, proteins, and vitamins. The synthesis of amino acids from urea is an example of the former. Most of the B complex vitamins and vitamin K are synthesized in the rumen.

Table II. [3,4]

| Microorganisms | Vitamins |
|---|---|
| *B. coli* (vitamin K) | |
| *Proteus vulgaris* | riboflavin |
| *B. fecalis* | thiamine |
| *B. lactis aerogenes* | niacin |
| *B. fecalis alcaligenes* | biotin |
| *B. mesentericus vulgates* | folic acid |
| | pantothenic acid |

These vitamins are important both for normal bacterial growth and the nutritional requirements of ruminants. Most of the fat soluble vitamins except vitamin K are not synthesized in the rumen and must be included in the ration. Another important point is that young ruminants do not have the same bacterial flora as adults and consequently are unable to synthesize some vitamins. This means that several of the B complex vitamins must be taken in the diet unless bacterial synthesis is assured.

Vitamin C is not synthesized in the rumen. In fact, it is rapidly destroyed in the rumen if it is included in the ration. Ruminants have a certain blood level of vitamin C hence it must be synthesized somewhere in the animal's body. The best thoughts on the subject are that it is synthesized by the tissues, possibly the liver.

## Role of the Individual Microorganisms

There is such a large number of bacteria in the rumen that it is almost impossible to classify each of them into an individual genus and species. They are usually classified into large groups according to some special characteristics. The following four groups of microorganisms have been studied to some extent:

1. Ciliates (Hungate)[10]
2. Pseudoyeast (Quin)[7,3]
3. Iodophilic bacteria (Baker, Van der Wath)[9,8]
4. Propionic acid bacteria (Elsden)[11]

*Ciliates*[6]. These organisms vary from 50,000 to over 2,000,000 per cml. depending on the type of feed. Right after a starch meal the protozoa will stain blue indicating they have ingested some of the starch. Later on they will stain a reddish brown indicating the starch has been converted to glycogen. Digestion of starch can, however, be accomplished by the ruminant without the aid of microorganisms. Under the microscope it can be seen that these organisms also ingest bacteria and bits of plant matter which presumably are digested and utilized for metabolism. Hungate has isolated a protozoa of the species diplodinia that is able to convert cellulose to sugar. It should be stated, however, that most ciliates do not digest cellulose.

The ciliates can be removed from the rumen of sheep by short periods of starvation. These animals free of ciliates remain in good health. From this, it is concluded that while some ciliates may help in the digestion of cellulose, they are not necessary for normal digestion.

*The pseudoyeast of Quin* (*Schizosaccharomyces ovis*). These organisms were found to produce gas and glycogen from glucose, and have a tendency to cause bloat. It is doubtful that they have any beneficial effect on normal digestion in the rumen.

*Iodophilic bacteria*[9]. These organisms are a heterogenous group of bacteria (mostly cocci) that stain blue with iodine. Baker[9] by special microscopic technic has been able to see those bacteria erode pits into particles of cellulose. It appeared that they were secreting enzymes that digest cellulose. Van der Wath[8] demonstrated that considerable digestion of starch is due to these bacteria. These organisms are probably the most important for cellulose digestion in the rumen.

*Propionic acid bacteria*[11]. The increased acidity that occurs in the sheep's rumen after adding glucose is due mostly to a rise in the

propionic and acetic acid content. This effect is in great part due to propionic acid bacteria. The glucose is first converted to the lactic or pyruvic acids by various organisms found in the rumen. Then the propionic acid bacteria convert lactic or pyruvic acid to propionic acid, acetic acid, and carbon dioxide. These organisms have been demonstrated in the rumen of sheep.

### The Utilization of the Microorganisms and Fatty Acids by the Ruminant

*Fatty acids.* In an analysis on ten sheep Phillipson[9] found that the average fatty acid content of the rumen varied from 26.8 to 91.1 gm. (average 64 gm.). The fatty acid content is greatest in the reticulum and rumen, less in the omasum, and nil in the abomasum, indicating that these acids are absorbed directly from the rumen. The average rate of absorption is about 5 gm. per hour in the sheep. This results in the absorption of about 100 gm. of fatty acids from the rumen per day. About 80% is acetic acid and most of the rest is propionic. Little acetic acid is found in the urine, for most of it is utilized by the tissues. The heart for example, can utilize acetic acid as well as glucose for metabolism. Propionic acid must be converted to glucose by the liver before it can be metabolized. It has been estimated that these fatty acids supply from 15 to 30% of the total nutritional requirement of sheep.

*Microorganisms.* Very few organisms found in the rumen pass out in the feces. These organisms are digested and assimilated by the animal. It has been calculated that an average cow digests 404 gm. of microorganisms per day. This would account for about 15% of the carbon contained in a daily ration of cellulose.

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## Feeding Experiments Using Twin Calves

Results of two feeding experiments with identical twin calves have been so encouraging that the BAI plans to purchase a third group of twins. These trials were started in 1950 with six pairs of twins, and were continued with ten pairs purchased in 1951.

The purpose of the experiments is to determine whether growing calves (about six months of age) fed only enough for a few months to keep them from losing weight, will grow rapidly and economically later, when put on adequate rations. In the experiment, one of the identical twins gets the limited ration; the other gets the full ration.

Results of the two feeding trials with the 16 pairs of twins indicated that growing calves given only enough feed, for as long as six months, to keep them from losing weight, will grow rapidly and economically later when put on adequate rations. However, it was found that the health of young animals must be protected while they are on limited rations; they should get liberal allowances of protein, minerals, and vitamin A (carotene).

Most of the twin calves in the Beltsville tests that had been on limited rations, reached slaughter weight within three months after the same weight (1000 lb.) was reached by their "co-twin" controls. Also, the meat of the calves fed limited rations was judged to be equal in quality to that of the well-fed controls.

It is possible now to predict, on the basis of these experiments, the number of energy units a certain calf will require in order to maintain its body weight, or the number of units needed to make gains in weight at any reasonable rate of growth. The experiments have shown, for example, that a 400-lb. calf needs about 5,400 calories daily just to maintain its weight. To gain 1.6 lb. a day, its daily need is about 12,500 calories.

# Anticoagulants In Veterinary Medicine

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WITHIN the past five years, a considerable amount of work has been done in the field of human medicine on anticoagulants. Much of the experimental work has been done on dogs and other laboratory animals. It is likely that in time anticoagulants will become of increasing importance in veterinary medicine. With this in mind the author presents this review of the current situation and his opinions on what may develop.

## Physiology of Coagulation

At present the exact mechanism of blood coagulation is not known. However, certain facts are generally accepted. This clot is formed by the action of thrombin on fibrinogen. Three substances are necessary for thrombin formation: thromboplastin (thrombokinase), calcium ion, and prothrombin. Thromboplastin is derived from blood platelets and damaged tissue cells. Prothrombin is formed in the liver; vitamin K is necessary for its formation.

This much must be accepted before the action of anticoagulants can be understood.

## Uses of Anticoagulants

1. *Drawing blood samples for clinical analysis.* At present this is the only use for which anticoagulants are used extensively (if it can be called that) in veterinary medicine.

Oxalate and citrate salts are generally used for this purpose. Recommended is 10 mg. potassium oxalate per 5 cc. blood. Minimum damage occurs to blood cells with this concentration. The oxalate is placed in sterile serum bottles with self-sealing rubber caps. Samples drawn aseptically into these bottles are sent through the mail and arrive in good condition for blood counts and chemical analysis. There is some slight shrinkage of erythrocytes, but not enough to be clinically significant. However, serious damage can be done by adding an excess of citrate or oxalate salts.

The use of ammonium oxalate should be avoided when urea nitrogen or N. P. N. determinations are to be made, since these determinations are based on the amount of ammonia recovered from the blood.

The mixture of 0.01 gm. sodium fluoride and 0.001 gm. thymol per cc. of blood recommended by Sander makes a good anticoagulant and blood preservative for blood chemistry determinations, but it should not be used where blood counts are to be made on the same sample.

The ideal anticoagulant for blood counts is heparin. A few grains are all that is needed to prevent coagulation in a 5 cc. sample. No shrinkage of erythrocytes or other discernible damage is found unless an excess is used. The expense of this substance has delayed its general acceptance for this purpose. Within a few years heparin or heparin substitutes will probably replace citrates and oxalates.

It is recommended that the syringe and needle used for drawing blood samples from dogs or cats be flushed out with citrate or oxalate solution before use, so that the blood will not coagulate before it can be placed in the sample vial.

2. *Thrombosis.* The chief use of heparin and dicumarol in human medicine is in the treatment and prevention of thrombosis. If the process of clot formation is stopped before the clot becomes organized, the clot will dissolve within the body. Different investigators have discovered variations in their results, but the available evidence indicates that anticoagulant treatment in acute thrombosis reduces fatalities to about 33% of what they were previously. Recovery is also much faster and more complete. Hospitalization time is often less than one week. The patient also returns to normal activity in a fraction of the time required for conventionally treated patients.

As a prophylactic measure anticoagulant treatment given a few hours after surgery markedly reduces postoperative loss from thrombosis and embolism. It has been used following cesarean section, which frequently results in thrombosis and embolism.

3. *Blood Transfusion.* To facilitate blood transfusion intravenous heparin (1 mg./kg.) has been used in human medicine. The injection is given to the donor a few minutes before the blood is withdrawn. The heparin

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is then neutralized by intravenous administration of protamine sulphate (2 mg./kg.). Since blood transfusions are so difficult in dogs and cats, this could be important. The author works in a laboratory with no facilities for keeping dogs and has had no opportunity to test this method. However, experimentation by many investigators leaves no doubt about the ability of heparin to retard coagulation, but there is some disagreement about neutralization with protamine sulphate. This drug neutralizes heparin in man, but Quivy failed to get the expected neutralization obtained by other investigators in the dog. Since the amount of heparin received by the patient is not large and most of it is gone from the blood within a few hours, this probably is of little importance in the patient. Even the donor does not receive proportionately a higher dose than human beings under treatment.

4. *Snake Bite.* Experimental evidence has shown that heparin can neutralize the coagulant fractions of many snake venoms, including cobra venom. Since most snake venoms contain strong blood coagulating substances, heparin (or possibly other anticoagulants) may eventually become a standard therapeutic measure for this purpose.

5. *Frostbite.* Excellent results in the treatment of acute frostbite with anticoagulants have been obtained in the treatment of human beings. Theis, O'Connor, and Wahl treated 14 acute frostbite cases with only one requiring amputation of a finger. The authors considered these results remarkable. In addition to anticoagulants, they used the conventional care of exposure to room temperature only, combating shock with blood and plasma infusions, pressure dressings, and antibiotic treatment to combat infection.

6. *Burns, Exudates.* Elrod, McCleery, and Ball have reported on the effect of heparin on laboratory animals receiving lethal burns. Heparin significantly increased the survival time. A smaller rise in nonprotein nitrogen and increased renal output was noted along with a decrease in expected hemoconcentration, probably due to better return of fluid and albumin to circulation.

The latter phenomenon is peculiar to heparin and apparently is in no way connected with its anticoagulant properties. Donzelot and Kaufmann claim that heparin regulates the fluidity of the blood by its effect on plasma proteins, modifying the blood proteins and changing the protein equilibrium. Their use of heparin injections resulted in rapid resorption of exudates in rheumatoid arthritis, progressive polyarthritis, pneumonia, and edema associated with phlebitis. Other investigators have substantiated their findings. Thus heparin may eventually gain widespread use for purposes which have nothing to do with its anticoagulant powers.

## Hemorrhagic Diseases Caused by Anticoagulants

Dicumarol and synthetic dicumarol-like products have lately come into use as rat poisons. They act as prothrombin inhibitors. Animals may come in direct contact with the poison through rat bait or perhaps indirectly by eating dead rats. The author feels the ingested rat theory is open to question, since it would appear that a dog, for example, would probably have to eat several rats within a short period to obtain a lethal dose.

Sweetclover poisoning has also been found to be due to the presence of dicumarol in the plants. This disease, a hypoprothrombinemia, manifests itself in a greatly increased clotting time. Death results from hemorrhage. Treatment consists of blood transfusions and vitamin K therapy.

Hypoprothrombinemia is thought to be the cause of the internal hemorrhages found in infectious hepatitis. Since the liver is the seat of prothrombin formation, extensive liver damage results in hypoprothrombinemia.

Occasionally a hemorrhagic condition associated with increased clotting time but no thrombocytopenia is found, and the cause is unknown. Bergstrom, Tomenius, and Wihman reported on such a case a few years ago. Several mast cells were found in the bone marrow. These cells are practically never found in normal human marrow. Since these cells are capable of producing heparin, they treated the case with the anti-heparinic protamine sulphate and succeeded in returning the patient's clotting time to normal.

Even though mast cells are capable of producing heparin, mast-cell tumors in dogs do not cause increased clotting times in affected animals.

## Heparin and Dicumarol

Dicumarol may be administered *per os*, but heparin must be given parenterally. This, plus the lower cost, represent the advantages of dicumarol over heparin. When a rapid increase in clotting time is desired, heparin must be used. Since heparin is antithrombic and has no effect on prothrombin, the dosage may be regulated simply by determining the clotting

time. With dicumarol, prothrombin time must be determined several times a day to determine if an overdose has been given. This is a much more difficult and time-consuming test than determining the clotting time. There is no direct antidote for dicumarol, but protamine sulphate (at least in man) given intravenously is a direct antidote for heparin. Thus it would appear that dicumarol has no future as a therapeutic aid in veterinary medicine, but heparin or synthetic heparin substitutes may become important drugs.

Recently work has also indicated that injectible trypsin may be used to dissolve clots in cases of thrombosis. Since this work is very recent, no comment will be made here.

The study of anticoagulants has become a complicated one, with new discoveries constantly occurring. Although anticoagulant therapy will probably never be used on more than a limited number of cases, the time will soon arrive when progressive-minded veterinarians will not be able to ignore it.

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"It is well known that in some cases the swine flesh takes on abnormal tastes and odors, arising from the feed used . . . In these cases it is evident that foreign compounds have been transmitted from the feed to the flesh, particularly the fatty tissues."—*Jour. An. Sci., Feb. 1953.*

## Health Without Drugs

Top-ranking livestock producers are beginning to realize the dangers of overtreatment. While recognizing that an ounce of prevention is worth a pound of cure, they are also cognizant of economic and humane aspects of necessary medical aid to ill animals. These growers are strictly opposed to the suggestion that an animal has to be a drug addict to live.

Some poultrymen have magnified their brand of preventive medicine to the degree that they market poultry that have eaten nothing but medicated feeds during their entire lives. It is against this group that Bob Parks (*Poultry Digest*, March 1953) bares his lance. As Mr. Parks so aptly says:

"Some nervous poultry growers seem to have forgotten that the chicken is a happy, healthy creature that literally pops into this world full of enthusiasm and vigor. It is equipped with a natural instinct to take care of its own good health if given half a chance.

"While we do not use vaccines . . . we do doff our hats to the great men of science who have developed these products. Vaccines properly used protect poultry against the onslaught of contagious diseases. A similar tribute can be paid to the makers of the better poultry drugs.

"Our criticism is directed against the overuse of these items, and the gradual development of a race of poultry growers who depend more upon these artificial health devices than upon good management and feeding."

Mr. Parks suggests a three-point plan for health without drugs:

1. Breeding for health.
2. Adequate clean quarters.
3. Managerial know-how.

Outstanding livestock producers are advocating the curbing of extensive home use of biological and pharmaceutical products. Promiscious use of these agents will not substitute for thoughtful husbandry.

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The use of formalin for inactivation of Newcastle disease virus and the addition of mineral oil and falba as adjuvants form the basis for a new immunizing agent recently developed by Mitchell and Walker, and Mitchell, Walker and Moynihan (*Can. Jour. Comp. Med.*, 16:409 and 411, 1952). Laboratory and field trials with this inactivated product indicate that it is capable of stimulating immunity for at least 13 months.

# The Relative Toxicity Of The Chlorinated Naphthalenes In Experimentally Produced Bovine Hyperkeratosis (X-Disease)†

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SINCE Olafson[5] first described bovine hyperkeratosis (X-disease), numerous reports have indicated that the disease is rather widespread and has been responsible for some severe economic losses. Evidence that the disease is caused by a toxic substance or substances has been presented in the reports of various investigators. Several seemingly unrelated substances have been incriminated in outbreaks, and in most instances have been used to produce the disease experimentally. Olson, Cook and Brouse[8] reported the appearance of the disease in a group of calves fed a particular lot of pelleted dehydrated alfalfa. Olson and Cook[9] were able to reproduce the disease with the pellets left over from the initial outbreak, and ruled out environment and contact as possible factors. Olafson and McEntee[6] produced the disease with a processed concentrate, and later McEntee, Hansel and Olafson[6] were able to produce hyperkeratosis with the free fatty acid fraction of the ether extract of the processed concentrate. Wagener[12] produced bovine hyperkeratosis with one lot of wood preservative used in Germany. Miller, Bortree and Shook[4] produced the disease by feeding a particular crop of timothy hay. Bell[1] reported the production of hyperkeratosis by the oral administration of a particular lubricant. In a second report Bell[2] identified the toxic factor in the particular lubricant as a highly chlorinated naphthalene. Sikes and Bridges[10] and Sikes, Wise and Bridges[11] in two later reports also described the production of bovine hyperkeratosis with chlorinated naphthalenes. Recently, Olafson, McEntee and Hansel[7] reported that the German wood preservative contained two active fractions. One of these was identified as probably being trichloronaphthalene and the second, although not positively identified, has some properties fairly close to those of trichlorobenzene. The accumulated evidence indicates that compounds other than the chlorinated naphthalenes are also capable of causing bovine hyperkeratosis.

Since the first report by the writer that highly chlorinated naphthalenes were capable of producing hyperkeratosis, studies have been made in cooperation with the Sinclair Refining Company and the Sinclair Research Laboratories, Inc., on the relative toxicity of the various compounds of this group. This report describes the results obtained.

## Materials and Methods

Normal calves were obtained from herds at the Virginia Polytechnic Institute, in which bovine hyperkeratosis is known not to have occurred. The ration, consisting of milk from the parent herd, home-grown hay, and a commercial grain supplement for calves, was identical to that used for calves in the parent herds. The calves were weaned before being used. They ranged in age from approximately two to four months and in weight from 87 to 268 lb. All calves were handled in the same manner except for exposure to the various chlorinated naphthalenes.

Seven samples of purified chlorinated naphthalenes were furnished by the Sinclair Research Laboratories, Inc. These were as follows:

| Compound | Per Cent Chlorine Theoretical | Actual |
|---|---|---|
| Dichloronaphthalene | 36.0 | 35.8 |
| Trichloronaphthalene | 46.0 | 47.8 |
| Tetrachloronaphthalene | 53.3 | 53.5 |
| Pentachloronaphthalene | 59.0 | 59.2 |
| Hexachloronaphthalene | 63.5 | 64.3 |
| Heptachloronaphthalene | 67.2 | 68.5 |
| Octachloronaphthalene | 70.3 | 70.0 |

These samples were purified to contain compounds of equal degrees of chlorination. Each fraction, however, contains several isomers

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†This work was done in cooperation with the Bureau of Animal Industry, USDA, under interregional agricultural experiment station research on the project entitled X-Disease (Hyperkeratosis) of Cattle.

which differ, not in the number of chlorine atoms in the molecule, but in the relative positions of these chlorine atoms on the naphthalene nucleus. The impurities that may be present are chlorinated naphthalenes of adjacent levels of chlorination; for example, the sample of tetrachloronaphthalene, of which there are 22 possible arrangements of the four chlorine atoms, will contain some tri- and pentachloronaphthalene.

The di-, tri-, tetra-, penta-, and hexachloronaphthalenes were put into a 3% solution, either in mineral oil, U.S.P., or in a vegetable oil. Because of their low solubility the hepta- and octachloronaphthalenes were given as suspensions in mineral oil to two calves each. A 1% solution of each compound was also administered to two calves. Each calf was given orally, by means of gelatin capsules, a predetermined amount of the chlorinated naphthalene. The amount to be administered was based on the body weight of the calf and the degree of chlorination of the compound given. The total amount for each calf was divided into small doses that were given over a period of several days. Table 1 identifies each compound and shows the total amount administered, the total milligrams per pound given each calf, and the days during which it was administered. Autopsies were performed, in general, when the calves became extremely weak or moribund.

**TABLE 1. Data on the Administration of Chlorinated Naphthalenes to Calves**

| Calf | Material* | Total Amt. gm. | Total mg./lb. | Days Adm. |
|---|---|---|---|---|
| 1495 | Di- -[1] | 2.1 | 14.0 | 1-7 |
| 1500 | " | 1.2 | 13.9 | 1-7 |
| 278 | Tri- -[1] | 2.1 | 12.0 | 1-10 |
| 277 | " | 1.2 | 7.5 | 1-7 |
| 1490 | Tetra- -[1] | 2.1 | 12.1 | 1-10 |
| | | 2.1 | 12.1 | 23-30 |
| 196 | " | 1.2 | 7.4 | 1-10 |
| | | 1.2 | 7.4 | 23-26 |
| 284 | Tetra- -[2] | 4.6 | 20.0 | 1-13 |
| 272 | Penta- -[1] | 2.1 | 10.0 | 1-10 |
| 273 | " | 1.2 | 5.4 | 1-7 |
| 1508 | Penta- -[2] | 1.7 | 7.5 | 1-5 |
| 275 | Hexa- -[1] | 2.1 | 11.6 | 1-10 |
| 192 | " | 1.2 | 10.0 | 1-7 |
| 280 | " | 1.0 | 5.0 | 1-7 |
| 282 | Hexa- -[2] | 1.4 | 5.0 | 1-6 |
| 283 | " | 0.6 | 2.5 | 1-5 |
| 197 | Hepta- -[3] | 1.5 | 7.5 | 1-7 |
| 198 | " | 0.5 | 3.3 | 1-8 |
| 190 | Hepta- -[4] | 0.6 | 2.5 | 1-8 |
| 285 | Hepta- -[5] | 0.9 | 5.0 | 1-9 |
| 199 | Octa- -[3] | 1.5 | 10.0 | 1-7 |
| | | 1.5 | 10.0 | 23-27 |
| 179 | " | 0.5 | 4.0 | 1-8 |
| | | 0.5 | 4.0 | 23-27 |
| 189 | Octa- -[4] | 1.1 | 5.0 | 1-11 |
| 1503 | Octa- -[5] | 1.7 | 10.0 | 1-9 |
| 191 | Mineral Oil, U.S.P. | 100.0 | 500.0 | 1-10 |
| 194 | Control | | | |
| 188 | Control | | | |

*- - = chloronaphthalene. 1. 3% sol. in mineral oil, U.S.P. 2. 3% sol. in vegetable oil. 3. Suspended in mineral oil, U.S.P. 4. 1% sol. in mineral oil, U.S.P. 5. 1% sol. in vegetable oil.

Symptoms exhibited on the 45th day by calf 273 which had received 5.4 mg./lb. of pentachloronaphthalene.

The calves that received dichloronaphthalene and trichloronaphthalene did not develop symptoms or lesions associated with hyperkeratosis during the period of observation. Calf 1495 was autopsied after 115 days and neither gross nor microscopic lesions of hyperkeratosis were found. Calves 1500, 278, and 277 showed no evidence of hyperkeratosis during 150 days of observation.

Two of three calves, 1490 and 196, receiving tetrachloronaphthalene developed mild symptoms associated with hyperkeratosis on the ninth and seventh days respectively. Both calves showed some lacrimation, slight nasal discharge, and some depression that persisted for several days, after which the calves appeared normal. The dosage was repeated during the 23rd to the 30th day. Slight symptoms that lasted for several days again appeared. At the end of 150 days of observation these two calves exhibited no symptoms of hyperkeratosis nor ill-effects from the tetrachloronaphthalene. The third calf, 284, receiving tetra-

## Results

A summary of the results is given in table 2.

**TABLE 2. Summary of the Effects of Chlorinated Naphthalenes on Calves**

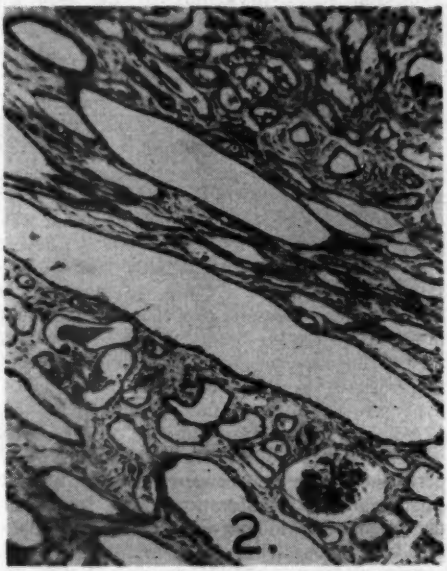
| Calf | Material* | Total mg./lb. | Days to Symptoms | Days to Autopsy | Remarks |
|---|---|---|---|---|---|
| 1495 | Di- - | 14.0 | .... | 115 | Negative |
| 1500 | " | 13.9 | .... | ..... | Negative |
| 278 | Tri- - | 12.0 | .... | ..... | Negative |
| 277 | " | 7.5 | .... | ..... | Negative |
| 1490 | Tetra- - | 24.2 | 9 | ..... | Recovered |
| 196 | " | 14.8 | 7 | ..... | Recovered |
| 284 | Tetra- - | 20.0 | .... | 81 | Negative |
| 272 | Penta- - | 10.0 | 7 | 22 | Hyperkeratosis |
| 273 | " | 5.4 | 7 | ..... | Recovered |
| 1508 | Penta- - | 7.5 | 4 | 22 | Hyperkeratosis |
| 275 | Hexa- - | 11.6 | 5 | 20 | Hyperkeratosis |
| 192 | " | 10.0 | 5 | 23 | Hyperkeratosis |
| 280 | " | 5.0 | 5 | 15 | Hyperkeratosis |
| 282 | Hexa- - | 5.0 | 4 | 22 | Hyperkeratosis |
| 283 | " | 2.5 | 4 | 29 | Hyperkeratosis |
| 197 | Hepta- - | 7.5 | 7 | 34 | Hyperkeratosis |
| 198 | " | 3.3 | 9 | 39 | Hyperkeratosis |
| 190 | Hepta- - | 2.5 | 8 | 96 | Hyperkeratosis |
| 285 | " | 5.0 | 4 | 14 | Hyperkeratosis |
| 199 | Octa- - | 20.0 | .... | ..... | Negative |
| 179 | " | 8.0 | .... | ..... | Negative |
| 189 | Octa- - | 5.0 | 8 | ..... | Recovered |
| 1503 | Octa- - | 10.0 | 6 | 21 | Hyperkeratosis |
| 191 | Mineral Oil | 500.0 | .... | ..... | Negative |
| 194 | Control | | .... | ..... | Negative |
| 188 | Control | | .... | ..... | Negative |

*- - = chloronaphthalene. See table 1 for forms in which compounds were given.

chloronaphthalene did not develop any visible symptoms or lesions of hyperkeratosis. Calf 284 was sacrificed at the end of 81 days, and no gross nor microscopic evidence of hyperkeratosis was found.

Calves 272, 273, and 1508, that received pentachloronaphthalene, developed marked symptoms, and two, 272 and 1508, were extremely weak by the 22nd day, when they were autopsied. Lacrimation, nasal discharge, salivation, red areas on the oral mucosa and gums, and depression were the dominant symptoms. Symptoms appeared on the seventh day in calf 272, and on the fourth day in calf 1508. The gross lesions at autopsy included: slight swelling of the kidneys, which were pale with a striated cortex; some mottling of the liver; distension of gall bladder; small cyst-like nodules on the mucosa of the gall bladder; a few small wart-like proliferations in the mouth; small ulcers and reddened areas of the mucosa of the abomasum near the pylorus; and some inflammation of the small intestine. Calf 273 developed symptoms on the seventh day (fig. 1) that persisted for several weeks. Lacrimation, salivation, nasal discharge, red areas in the mouth, depression, indentation of hoof and horn, and slight wrinkling of the skin over the neck were observed during a period of about 60 days following the administration of the pentachloronaphthalene. The symptoms gradually receded, and at the end of 150 days this calf presented neither visible symptoms nor external lesions of hyperkeratosis.

The five calves that received hexachloronaphthalene developed symptoms by the fifth day, and all came to autopsy between the 15th and 29th days. Symptoms in this group of calves included lacrimation, nasal discharge, salivation, red areas on the oral mucosa, anorexia, depression, indentation of horn, and finally extreme weakness or prostration. Gross lesions found at autopsy in this group of calves included: enlarged kidneys that were gray in color and had a striated cortex; light-colored areas on the surface of, and extending into the




Dilatation of kidney tubules in calf 275 which had received 11.6 mg./lb. of hexachloronaphthalene.

parenchyma of, the liver; flat erosions of the mucosa of the abomasum near the pylorus; distention of the gall bladder with bile; cyst-like nodules on the mucosa of some and edema of the gall bladder wall in others; some inflammation of the small intestine; and small wart-like proliferations at various sites in the mouth.

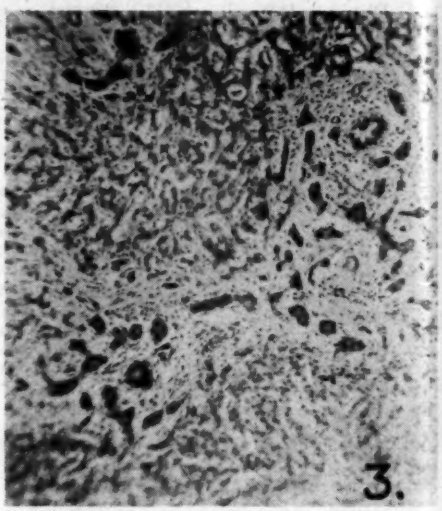
Calves 197 and 198 received heptachloronaphthalene suspended in mineral oil, U.S.P.

Calf 190 received the compound in a 1% solution in mineral oil and calf 285 received it in a 1% solution in vegetable oil. Symptoms appeared in all calves in from four to nine days. The symptoms observed were lacrimation, salivation, nasal discharge, red areas on the oral mucosa, and depression. Calves 197 and 198 were autopsied on the 34th and 39th days respectively. Calf 285 was moribund on the 14th day, while calf 190 was sacrificed on the 96th day after the development of extensive hyperkeratosis. The autopsy findings in this group of calves included: enlarged, gray-colored kidneys with striations of the cortex; some evidence of fibrosis in the livers of two calves; nodules in the vaginas of the two females (190 and 198); either normal or moderately distended gall bladders, with cyst-like nodules on the mucosa of one; small ulcers in mucosa of abomasum near the pylorus; wart-like proliferations in the mouths of two; marked thickening of the skin of calf 190, and slight thickening of the skin of calf 197.

Of the four calves that received octachloronaphthalene, the two, 199 and 179, that were given the compound suspended in mineral oil remained normal. The dosage was repeated from the 23rd to the 27th day without ill-effects. These two calves did not present symptoms or external lesions during the 150-day period of observation. Calf 189, that was given octachloronaphthalene in solution, developed symptoms, which included lacrimation, salivation and nasal discharge by the eighth day. These symptoms persisted more or less in a mild degree for about 50 days, after which the calf appeared normal and exhibited no further visible evidence nor external lesions of hyperkeratosis during the remainder of the 125-day period of observation. Calf 1503 was moribund in 21 days, when an autopsy was performed. The hooves were indented; several small wart-like proliferations were found on the tongue; the kidneys were enlarged and pale in color; a few light-colored areas were present on the surface of the liver; and the gall bladder was distended and the wall thickened.

During the period of observation, calf 191, which was given mineral oil, and calves 188 and 194, which received no treatment, remained free from symptoms. During the same period, no evidence of hyperkeratosis was found in the calves or older animals in the parent herds.

Microscopic examination of tissues obtained at autopsy revealed changes in agreement with those reported by the authors previously cited. Dilatation of the tubules of the kidney (fig. 2) was the most pronounced change found. Varying degrees of bile duct proliferation (fig. 3), occasional cellular infiltrations and areas of degeneration were seen in most liver sections. Dilatation of the glands of the gall bladder was present in some cases. Some squamous metaplasia of the epididymides was found in a few cases. The proliferative lesions in the oral mucosa were similar to those previously reported. There was some keratinization of the hair follicles in a few instances but, with the exception of calf 190 (figs. 4, 5), the accumulation of keratinized material on the skin was negligible.




Bile duct proliferation in the liver of calf 283 which had received 2.5 mg./lb. of hexachloronaphthalene.

## Discussion

The di- and trichloronaphthalenes were not toxic under the conditions of the study. That they are considerably less toxic than the more highly chlorinated compounds is shown by the negative results obtained, even though about four to five times the amount per pound body weight was given than in the case of the more highly chlorinated naphthalenes.

The slight toxicity of tetrachloronaphthalene was indicated by the appearance of mild symptoms in two of three calves receiving this compound. Approximately six to nine times more was given than of the hexa- and hepta-chloronaphthalenes without producing severe toxic effects or permanent damage, judging by the severity and persistence of symptoms. It is possible, of course, that larger amounts or

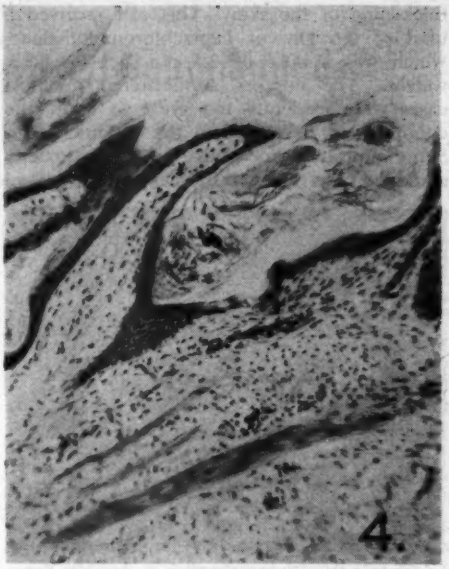
a longer period of administration might produce more damage. Calf 284, that developed no symptoms, weighed at least a third more than the other two in this group, but, since the compound was given on a weight basis, this difference in weight probably does not account for the difference in response. The fact that calf 284 was given tetrachloronaphthalene in vegetable oil rather than in mineral oil is also probably not significant since the more highly chlorinated naphthalenes were toxic in both vehicles.

Pentachloronaphthalene was quite toxic under the conditions of its administration, although less so than the hexachloronaphthalene. The vehicle used apparently did not influence the results. In the two calves, 272 and 273, of approximately equal ages and weights, the difference in response was probably related to the amounts given rather than to other factors.

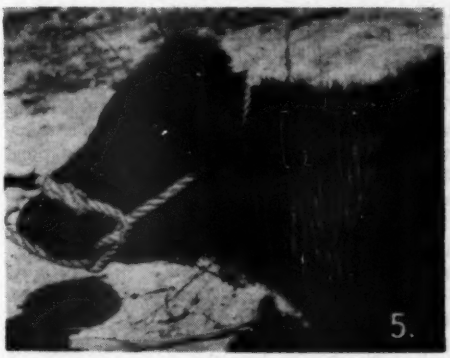
Using as criteria the appearance and severity of symptoms, the amounts given, and the rapid course of the disease, hexachloronaphthalene was the most toxic of the chlorinated naphthalenes used. Although the total dosages ranged from 2.5 to 11.6 mg. per lb. body weight, the responses of the individual calves were very similar. Again the vehicle, age, and weight of the calf exerted no marked influence on the outcome. The calf (283) receiving the smallest total amount per pound body weight (2.5 mg./lb.) survived the longest period, but the difference in survival time was not great enough to be significant.

Heptachloronaphthalene produced toxic effects when given either in suspension or in solution. Calves 197 and 198, which received the material in suspension, survived for a longer period (34 and 39 days respectively) than did the calves receiving penta- or hexachloronaphthalene in solution, although the amounts given per pound body weight were within comparable ranges. Heptachloronaphthalene in solution given in a total dose of 5.0 mg. per lb. body weight was as toxic as hexachloronaphthalene given at this level; however, at the total dose of 2.5 mg. per lb. it was less toxic and produced chronic hyperkeratosis. There is apparently less absorption of the heptachloronaphthalene when given in suspension than when given in solution.

Octachloronaphthalene, when given in suspension in total amounts up to 10 mg. per lb. body weight, failed to produce visible toxic effects. Continued administration of the compound or the administration of larger doses may result in the absorption of sufficient amounts to produce damage. This compound




Skin of calf 190 at the 96th day. Calf had received 2.5 mg./lb. of heptachloronaphthalene.




Calf 190 showing hyperkeratosis at the 60th day.

in solution was absorbed in sufficient amounts at the total dose of 5.0 mg. per lb. body weight (calf 189) to cause symptoms to appear. This calf was never severely affected, and at the end of a 125-day observation period was normal in appearance. Calf 1503, which received a total of 10 mg. per lb. body weight, developed marked symptoms and was moribund in 21 days. Octachloronaphthalene under the conditions of the experiment was less toxic than the hexa- and heptachloronaphthalenes.

In general, the course of the condition produced in the calves by the chlorinated naphthalenes was rapid. Only one calf (190) progressed to the chronic stage with marked

thickening of the skin. This calf received a total of 0.6 gm. of heptachloronaphthalene, which was a dose of 2.5 mg. per lb. body weight. The dosages administered in most cases were evidently too great to allow the condition to develop into the chronic form. Some additional knowledge as to the toxicity of the chlorinated naphthalenes may be gained

Calf 1481 showing hyperkeratosis at the 117th day. This calf (Bell[5]) had received approximately 2.2 mg./lb. of a highly chlorinated naphthalene which was mostly hexachloronaphthalene.

from one calf previously reported (Bell[5]). This calf (1481) received a total of 0.45 gm. of chlorinated naphthalenes or about 2.2 mg. per lb. body weight. It is estimated that of this amount approximately 0.3 gm. was hexachloronaphthalene. This calf had developed typical hyperkeratosis when autopsied on the 203rd day (fig. 6).

It is not possible to draw final conclusions concerning the relative toxicity of the chlorinated naphthalenes, because of the comparatively few calves used in the study. Some indications of their toxicity have been obtained, however, and the procedure of administering the compounds on a weight basis affords a means of standardizing technics. It should be remembered also that the many possible isomers of the various chlorinated naphthalenes were not subjected to study. There is reason to believe, however, that the various isomers of a chlorinated naphthalene would have equal toxicity.

Chlorinated naphthalenes have been used as an additive to some extreme pressure lubricants. Only a few of the many lubricants now on the market, however, contain this chemical additive. Although these compounds have many other uses, such as in the insulation of electric wires, it is probable that the major source of the chlorinated naphthalenes available to cattle would be through lubricants. The data previously reported (Bell[3,5]) and the data reported herein indicate that only a small amount of lubricant containing chlorinated naphthalenes is capable of having a toxic effect. For example, a 200-pound calf may need only 25 gm. of a lubricant containing 2% of hexachloronaphthalene to exhibit symptoms of the toxic effects. In spite of the fact that most lubricants to which cattle may be exposed will not contain chlorinated naphthalenes, undue exposure to lubricants should be avoided. It must also be remembered that other compounds appear to be capable of producing bovine hyperkeratosis. It is entirely possible that the majority of cases are caused by substances other than lubricants containing chlorinated naphthalenes.

## Summary

The symptoms and lesions produced by various purified chlorinated naphthalenes have been described. These are in general agreement with those reported by others as being characteristic of bovine hyperkeratosis, although the prolonged chronic disease was produced in only one instance. Dichloronaphthalene and trichloronaphthalene were not toxic at the total dose of 14 and 12 mg. per lb. body weight respectively. Tetrachloronaphthalene appeared to be slightly toxic under the conditions of the study. Penta-, hexa- and heptachloronaphthalene were consistently toxic; pentachloronaphthalene is probably less toxic than the latter two. As little as 2.5 mg. per lb. body weight of hexa- and heptachloronaphthalene caused the production of symptoms. Octachloronaphthalene given in suspension did not have a toxic effect, but 5.0 mg. per lb. body weight given in solution produced symptoms. Control calves and calves in the parent herds, which were fed the same ration as the experimental calves, showed no hyperkeratosis or dietary deficiencies during the period of these observations.

## Acknowledgments

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(*Continued on page 146*)

# The Clinical Evaluation Of Mixed Sulfonamides In Bovine Practice

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SUCCESSFUL treatment of the numerous bacterial infections that occur in cattle offers complexing problems. In many instances, proper livestock management and sanitation are not practiced. Inadequate and unclean quarters, fatigue, improper feeding, and lowered natural resistance serve to predispose animals to such infections. Efforts have been made by veterinarians and leaders in the animal industry to inform livestock raisers and thus to prevent some of these predisposing causes of animal diseases. Veterinarians generally have accepted the responsibility for giving assistance in management problems relating to disease control and to employing modern curative agents that have proved specificity.

The introduction of new chemotherapeutic agents has given us tools for successful treatment of many diseases. Favorable prognosis can be given whereas formerly prognosis was unfavorable. The rapid introduction of new and improved agents presents a challenge to veterinarians to select those that achieve their primary function with efficiency and rapidity and without undue toxicity when administered in adequate dosage. Of all the chemotherapeutic agents introduced in recent years, none has experienced greater utility than have those in the sulfonamide group. Among these, sulfamerazine and sulfamethazine have been found to be the most satisfactory in the treatment of the large variety of infectious diseases common in general practice.

No doubt one of the numerous reasons for the wide acceptance of these two sulfapyrimidine compounds has been the realization of their tremendous economic value due to their relative low cost, rapid absorption, and slow excretion. It has been demonstrated that in cattle 0.5 gr. of sodium sulfamerazine per pound of body weight administered intravenously establishes a blood concentration of 15.3 mg. / 100 cc. one hour after the injection[1]. Sodium sulfamerazine effectively maintained high blood levels for long periods of time. Also, it was excreted more slowly than are most other sulfonamides, as evidenced by the fact that after the intravenous injection according to the preceding schedule there existed, 24 hours later, a blood concentration of 2.5 mg. / 100 cc. Maintaining these levels for such periods of time has both economic and clinical value. Clinical studies with sulfamerazine have proved that this drug is an efficient agent for the treatment of a number of systemic diseases.

Candlin[2] employed the oral and intravenous administration of sulfamerazine and its sodium salt in the treatment of foot rot in 34 cows and one bull. His report stated that 33 animals recovered completely but, in one case where there existed suppuration and necrosis of the deeper structures, a second intravenous dose was required on the third day in conjunction with oral administration of the drug for several days. No toxic signs were manifested in any of the animals during or following completion of the treatment.

McAuliff and Phillips[3] described the highly beneficial results obtained by the use of sulfamerazine and its sodium salt in the treatment of infectious pododermatitis, metritis, and mastitis. In another publication, McAuliff[4] stated that in 180 cases of pneumonia and hemorrhagic septicemia in cattle treated with sulfamerazine and sodium sulfamethazine he observed a recovery rate of 95% in mature cattle and 93% in calves. He stressed the fact that a delay of several days before the administering of sulfamerazine for the treatment of shipping fever complicated with pneumonia may retard recovery and prolong convalescence.

Wastrack & Lewis[5] found sulfamerazine to be an effective and safe chemotherapeutic agent when it was properly administered for the treatment of pneumonia and septicemia associated with metritis and mastitis in cattle. His data indicated that the response to sulfamerazine was more rapid, and the period of treatment shorter, than with other sulfonamides.

Sulfamethazine has been found both experimentally and clinically to have practically the same therapeutic value as does sulfamerazine. It, too, is an economic drug for the

treatment of animal infections. Rapid absorption and slow excretion permit persistent high blood levels to be maintained. Welsh, *et al*,[6] using cattle as experimental animals, demonstrated that the administration of sulfamethazine, the dimethyl derivative of sulfadiazine, maintained the highest blood concentration of seven sulfonamides tested, over a 24 hour period and following a single dose of each drug.

Johnson and Roberts[7] presented evidence, accumulated during a six-month period, that therapy with sodium sulfamethazine alone or combined with penicillin was an effective method of overcoming infections of the udder. The compound produced no untoward effects on the udder tissue. Christian[8] later reported obtaining the same satisfactory results with sulfamethazine in the treatment of acute and chronic mastitis.

The desired success with the use of individual sulfonamides never was fully effective in human patients because of the existence of certain toxic manifestations. Fortunately many of these idiosyncracies in human patients rarely are observed in animals. The most serious toxic manifestation observed is renal obstruction due to the precipitation of the compounds in the renal tubules or pelvis.

Lehr[9] pointed out that the utilization of a combination of different sulfonamides of partial dosages in the same solution lessens the chance of renal toxicity. Each sulfonamide compound in the same solution and in urine will approximate its own solubility without affecting the solubility of the other agent. Theoretically, these combinations offer wider therapeutic activity and lower toxicity because of greater absorption, slower excretion, and a diminution in the intratubular deposition of sulfonamide crystals.

For the above reason this principle of drug mixtures should be applied when it becomes necessary to increase dosages beyond the normal limits in order to obtain wider or more powerful antibacterial activity. The risk of renal complications from the use of a single compound may lead to the administration of an inadequate or ineffective dose. Following our observations[10] with merameth® in the treatment of enteritis-pneumonia in swine (93.7% recovery among 504 treated animals) it was decided to continue investigation of this mixture as an agent by using it in the treatment of serious bovine diseases.

## Calf Diphtheria

Table 1 records 21 cases of calf diphtheria treated with merameth. It has been our experience that *Actinomyces necrophorus* infection of the laryngeal area does not limit itself to young calves. Severe outbreaks of this disease may appear in yearlings and mature animals up to two years of age. The incidence of anaerobic *Actinomyces necrophorus* infection as it occurs in various forms in beef and dairy cattle has increased extensively throughout our western area. This organism is so widespread in nature that infections by it in animals are not limited to those kept in poor and unclean surroundings. Sporadic or enzootic forms of necrotic laryngitis are found on well managed farms. The disease is most prevalent during the winter and spring months. The initial signs appear with rapid onset after the causative organism has entered the tissues and the lesions are extensive. The animal is depressed and has severe inspiratory dyspnea. Labored mouth breathing with roaring is aggravated by profuse slobbering and a swollen

®Sterile solution of sodium sulfamerazine (5%) and sodium sulfamethazine (5%), Sharp and Dohme, Philadelphia, Pa.

**TABLE 1. Calf Diphtheria (Necrotic Laryngitis)**

| No. Animals | Breed | Approx. body wt. lb. | Temp. Initial exam. F. | Treatment (merameth) I. V. | Results Recov. | Results Died | Remarks |
|---|---|---|---|---|---|---|---|
| 8 | H | 700 - 900 | 104.4 - 105 | 350 - 450 cc. | 8 | 0 | 5 responded promptly with 1 dose; 3 had been sick for several days; 2 required 2 doses; and 1, 3 doses |
| 3 | G | 750 | 104 - 106 | 375 cc. | 3 | 0 | |
| 3 | H | 200 - 250 | 105.5 - 106 | 100 - 125 cc. | 3 | 0 | |
| 6 | H | 400 - 500 | 104.8 - 105.6 | 200 - 250 cc. | 6 | 0 | |
| 1 | G | 650 | 106.5 | 350 cc. | 1 | 0 | Required a dose of 350 cc. on 2 successive days |
| 21—Total | | | | | 21 | 0 | |

H—Hereford, G—Guernsey  I. V.—Intravenous Administration

protruding tongue. Examination of the oral cavity reveals the offensive odor characteristic of necrophorus infection, ulcerations of the buccal mucosa, and the typical gray-yellow necrotic pseudomembrane on the larynx and pharynx. In acute forms of the disease, body temperature rises to 105 - 106 F. As table 1 indicates, one intravenous dose of merameth usually was sufficient to produce a favorable response. A follow-up 24 hours later revealed an appreciable drop in body temperature, in most cases the animal taking some food and water and otherwise exhibiting evidence of improvement.

### Pneumonia

Table 2 represents data for 31 cases of pneumonia associated with shipping fever, probably pasteurellosis. This syndrome as a rule effects young cattle who have undergone a period of excessive fatigue, undue exposure, chilling, or improper feeding during transit from one place to another. The Pasteurella organisms, considered to be normal habitants of the respiratory mucous membranes, become exceedingly virulent, probably because of lowered resistance, and set up a septicemia and lobar pneumonia.

Our diagnosis in the acute stage is based upon history, sudden onset, high temperature of 106-108 F., inappetence, rapid respiration, and severe dehydration.

The treatment employed was the injection of 0.5 cc. of merameth per lb. of body weight intravenously in one dose on the first day. Results were good, especially where the treatment was begun early in the course of the disease.

### Foot Rot

Foot rot, infectious pododermatitis, or interdigital phlegmon also is considered by Flint & Jensen[11] to be caused by *Actinomyces necrophorus*. Not only is the incidence of new cases increasing greatly, but new cattle in some ranch areas are plagued with this condition every year. Each animal and affected foot should be examined carefully in order to establish an accurate diagnosis.

It is believed that the true case of interdigital phlegmon (foot rot) is found in the hyperacute infection. This condition usually is accompanied by metastatic pneumonia, liver abscesses, or some other active infection localized in the body. Although the animal is lame in one or more feet in the early stages, no visible lesion or break in the continuity of the skin is noted. The infection does not extend beyond the fetlock. Examination reveals a tender reddened foot or feet with acute

**TABLE 2. Pneumonia**

| No. Animals | Breed | Approx. body wt. lb. | Temp. Initial exam. F. | Treatment (merameth) I. V. | Results Recov. | Results Died | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | H | 800 | 106 | 400 cc. | 1 | 0 | |
| 1 | H | 900 | 104 | 450 cc. | 0 | 1 | Had anaplasmosis in addition to pneumonia |
| 1 | H | 850 | 107 | 425 cc. | 1 | 0 | |
| 1 | H | 800 | 108 | 400 cc. | 0 | 1 | Moribund, died several hours after treatment |
| 1 | H | 800 | 105 | 400 cc. | 1 | 0 | |
| 1 | H | 850 | 106 | 425 cc. | 1 | 0 | Improved on second day but was treated again as its temperature was still 103 F. |
| 1 | H | 800 | 104.6 | 400 cc. | 1 | 0 | |
| 24 | H | 450 - 500 | 105 - 108 | 225 - 250 cc. | 23 | 1 | 24 weaner calves shipped from Montana to Livermore, Calif: 1 calf died 6 hours after treatment, practically moribund when seen; 3 were treated on 2 successive days, but recovered; 1 calf was treated 3 times and although it lived did not make satisfactory growth; the others responded with one handling and needed no further therapy. |
| 31—Total | | | | | 28 | 3 | |

H—Hereford I. V.—Intravenous Administration

swelling. The body temperature is elevated and may be 106 - 107 F. In acute cases there is progression of the disease to the tarsal joints but as a rule only one foot is involved. Careful observation will disclose a break either in the foot proper, between the claws, or over the coronary band. Chronic conditions exhibit no extreme swelling but the foot has been opened for some time and there is involvement of the deeper structures. A suppurating sinus or abscess will discharge purulent debris and necrotic tissue.

Treatment with sulfonamides usually is successful when the infection is confined to the skin and subcutaneous tissue. Table 3 summarizes data on animals treated for foot rot included in this study.

### Actinobacillosis

So called wooden tongue or lumpy jaw caused by *Actinobacillus lignieresi* is common in cattle. The disease is characterized by slowly developing hard tumorous masses involving the soft tissues in any part of the body.

**TABLE 3. Foot Rot**

| No. Animals | Breed | Approx. body wt. lb. | Temp. Initial exam. F. | Treatment (merameth) I. V. | Results Recov. | Results Died | Remarks |
|---|---|---|---|---|---|---|---|
| 3 | H - steers | 950 - 1000 | 104 - 104.6 | 475 - 500 cc. | 3 | 0 | |
| 3 | H - calves | 350 - 400 | 103.6 - 105 | 175 - 200 cc. | 3 | 0 | Recovery prompt |
| 20 | H&G Cows | 1000 | 104.6 - 105 | 500 cc. | 20 | 0 | 17 showed immediate improvement and made satisfactory recoveries; 1 had existed for sometime and gradually improved (received 3 treatment 2-3 days apart); 1 cow had an infected joint and another had infection of tendon sheaths and these remained lame |
| 9 | H - bulls | 1200 - 1500 | 104 - 105.5 | 600 - 750 cc. | 9 | 0 | 7 improved in several days (2 were treated twice at intervals of 5 days); 1 recovered a week later; the other developed an abscess over the coronory band—gradual recovery. |
| 35—Total | | | | | 35 | 0 | |

H—Hereford, G—Guernsey I. V.—Intravenous Administration

**TABLE 4. Actinobacillosis — "Wooden Tongue"**

| No. Animals | Breed | Approx. body wt. lb. | Temp. Initial exam. F. | Treatment (merameth) I. V. | Results Recov. | Results Died | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | H - steer | 600 | ..... | 300 cc | 1 | 0 | Successful recovery though on verge of death from starvation |
| 1 | H - steer | 800 | 101.6 | 400 cc | 1 | 0 | Edema of mandibular area; second treatment required |
| 1 | H - Heifer | 700 | normal | 350 cc | 1 | 0 | 2 doses, 3 days apart |
| 5 | G - cows | 900 - 1100 | 101.2 - 102 | 450 - 500 cc. | 5 | 0 | 1 cow was not treated for 7 days after the first dose and the induration did not subside with second dose; 4 cows responded promptly with 2 doses |
| 3 | H - bulls | 1250 - 1300 | 100 - 101.4 | 625 - 650 cc. | 3 | 0 | 1 case was of 30 days duration; given 3 doses; the other 2 responded with 2 doses |
| 11—Total | | | | | 11 | 0 | |

H—Hereford, G—Guernsey I. V.—Intravenous Administration

They are, however, seen most frequently in the regions of the lower jaws and neck. Pronounced signs are extreme swelling of the intramandibular space, excessive salivation, and a thickened protruding tongue.

Attempts to control this infection with one dose of merameth were made in some of these cases, when they were not too severe, but there were many recurrences. As shown in table 4, in this series 0.075 gm. of sulfonamides per kilogram (0.5 cc. merameth per lb. body weight) were administered and the animal treated again two to four days later. Results were quite remarkable. One steer had protrusion of a greatly swollen tongue. The usual intravenous sulfonamide therapy was given and on the second visit three days later, the tongue was functional and the animal beginning to eat. This steer made a successful recovery even though on the verge of death from starvation when first examined and treated.

## Mastitis

Most cases of gangrenous mastitis are considered to be due to the toxin of *Staphlococcus aureus* and they usually appear one week to a month after calving. The affected quarter is cold and secretes a blood-stained watery fluid. A discoloration of the skin of the involved quarter is noted. Treatment of the infected quarter is considered to be useless since the tissue will slough if even the cow does not die. Table 5 contains data on 13 cases of mastitis included in this study. Among the 11 cows that lived, two were given a second dose on the day following initial treatment. The others were given one dose and the quarter either was milked frequently or, as was the usual procedure, the teat was amputated to obtain ample drainage.

Five cows with severe clinical mastitis involving one quarter in three, and two quarters in the other two, were managed by infusing 50 cc. of merameth into the teat canal and by injecting the remainder of the 500 cc. in the bottle intravenously at the first treatment. Fifty cc. of the combined sulfonamide were infused into the teat the following day. Four cases recovered after the two treatments.

## Summary

1. The disease conditions of cattle included in this study and the therapeutic results obtained by using merameth (a sterile solution

**TABLE 5. Mastitis**

| No. Animals | Breed | Approx. body wt. lb. | Temp. Initial exam. F. | Diag. | Treatment (merameth) I. V. | Results Recov. | Results Died | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | G | 1000 | 106.2 | Gangrenous Mastitis | 500 cc. | 0 | 1 | Very toxic, could not rise |
| 1 | H | 1200 | 104.8 | " | 600 cc. | 1 | 0 | |
| 1 | H | 1100 | 105.8 | " | 500 cc. | 1 | 0 | Temperature 104.6 F. on second day, second dose given, recovery |
| 1 | H | 1200 | 105 | " | 600 cc. | 1 | 0 | |
| 1 | G | 1100 | 107 | " | 550 cc. | 1 | 0 | |
| 1 | H | 1200 | 106 | " | 600 cc. | 1 | 0 | |
| 1 | G | 1100 | 105.4 | " | 500 cc. | 0 | 1 | Toxic, also evidence of pneumonia |
| 1 | J | 1000 | 106.4 | " | 500 cc. | 1 | 0 | Second treatment necessary |
| 1 | J | 1000 | 103.8 | Mastitis | I.V. and Intramammary infusion | 1 | 0 | Intramammary infusion 50 cc. dose, always repeated when second intravenous dose necessary |
| 1 | G | 1200 | 105.4 | " | " | 1 | 0 | |
| 1 | Her. | 1100 | 106 | Mastitis | I.V. and Intramammary infusion | 1 | 0 | |
| 1 | H | 1100 | 104.6 | " | " | 1 | 0 | Much induration of 2 quarters that were involved. |
| 1 | H | 1200 | 105.4 | " | " | 1 | 0 | |
| 13—Total | | | | | | 11 | 2 | |

G—Guernsey, H—Holstein-Friesian, J—Jersey, Her—Hereford I. V.—Intravenous Administration

containing 5% sodium sulfamerazine and 5% sodium sulfamethazine) are given.

2. The therapeutic value of the mixture was proved, especially where the treatment was begun early in the course of the disease.

3. The mixture maintains high blood concentrations of the sulfonamides for prolonged periods.

4. In acute systemic infections it is desirable to administer merameth intravenously or in some cases intraperitoneally, depending upon the facilities available. Intramammary infusion is recommended for the treatment of mastitis.

5. Merameth is a safe, effective chemotherapeutic agent for the treatment of calf diphtheria, pneumonia, foot rot, actinobacillosis, gangrenous mastitis, and mastitis.


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Random sampling of sera from dogs in widely separated areas in the United States has indicated an average incidence of infectious canine hepatitis of approximately 50%.

## Bovine Hyperkeratosis

*(Continued from page 140)*

Guss, H. K. Royer, and G. J. Fleck, Lynchburg, Va., for their continued interest and encouragement.


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## Injectables Tested In Grub Control

U. S. Department of Agriculture scientists are experimenting with synthetic chemical injections to control cattle grubs. Expectation is high, and the results preliminary, however each of the three chemicals injected has successfully killed the grubs.

Whether these insecticides will eventually prove economical and safe has not been determined. Injected under the skin, the chemicals enter the blood stream, and reach the grubs feeding on the flesh. Dose thus obtained is sufficient to kill.

The screwworm fly, horn fly, deer fly, and mosquito also show promise of succumbing to these methods.

# Onset Of Resistance And Duration Of Immunity To Distemper In Ferrets Following A Single Injection Of Avianized Distemper Vaccine

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THE concept of immunization against viral infections with live, modified agents dates back to the 18th century when the first effective prophylactic measure was successfully undertaken by man. Indeed, even before the founding of the science of microbiology, Jenner[1] recognized that the exudate derived from cows infected with cowpox, a relatively mild infection of this species, was capable of protecting man against smallpox when scarified on the skin of the susceptible individuals. It was shown later that this exudate or calf lymph harbored a virus, cowpox or vaccinia, which is closely related to but much less pathogenic to man than the agent responsible for smallpox or variola. In their search for immunizing methods against other virus diseases, microbiologists have attempted to simulate this natural phenomenon by developing modified agents which would be comparable to vaccinia, both in their lessened virulent nature and in their ability to protect. The first laboratory-prepared, modified virus to be used in man on a worldwide scale was that of yellow fever, first grown in tissue culture[2] and subsequently adapted to the chick embryo[3]. More recently, several investigators have developed other modified viruses which are being widely used for immunization against Newcastle disease,[4] rabies,[5] distemper,[6,7,8] and hog cholera[9]. The methods involved in the search for modified agents consist of either the isolation and controlled multiplication of a naturally mild strain of an infective agent, or the adaptation of a virulent strain of virus to a host which is not normally susceptible to it.

Prior to its adaptation to the chick embryo, the modification of canine distemper virus had been reported by Green and Swale,[10] who claimed to have obtained it by serial passage of a virulent strain of the virus through susceptible ferrets. This so-called ferret-modified strain of virus became increasingly virulent for the ferret but, according to the authors, gradually lost a great deal of its virulence for dogs and foxes. The ferret, however, is one of the animals most susceptible to distemper under natural conditions, and it is difficult to conceive how a true modification of the pathogenic characteristic of the virus could have taken place in that host. Nevertheless, this ferret-adapted virus was extensively used for the immunization of dogs, and, as Bodin pointed out,[11] was not devoid of danger. Furthermore, the ferret-adapted virus was also recommended as a therapeutic agent for clinical distemper,[12] on the basis of the interference or cell-blockade phenomenon.

The purpose of this communication is to report results of experiments designed to determine the time of onset of resistance and duration of immunity to distemper in the ferret following a single injection of avianized®

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vaccine. It also describes the results obtained with avianized vaccine when used therapeutically in experimentally infected ferrets.

## Materials and Methods

*Avianized distemper vaccine.* This was prepared from the virus derived from a field case of "encephalitis" in the dog and adapted to the chick embryo in this laboratory[6]. The vaccine used in this study was the same as that currently available on the commercial market* and was injected into experimental animals by the intraperitoneal route immediately following reconstitution with the accompanying diluent.

*Ferrets.* Ferrets were used in this study as the experimental animal of choice, first, because of the unequivocal nature of the results obtained and, secondly, because of the relative ease with which they can be secured, handled, and maintained in isolation. They were obtained from the same source as reported earlier[6] and maintained under the same conditions.

*Challenge virus.* This consisted of a 20% ferret spleen suspension infected with the Lederle stock strain of virulent distemper virus. The suspension had previously been dried from the frozen state in glass ampoules and titrated in ferrets. The challenge dose, representing about 1000 m.l.d.'s,** was given to experimental animals by the intraperitoneal route.

## Experimental

1. *Therapeutic use of avianized distemper vaccine in experimentally infected ferrets.* On September 20, 1949, each of 12 normal susceptible ferrets was inoculated intraperitoneally with about 1000 m.l.d.'s of virulent distemper virus. Immediately following this injection each of ten of these ferrets received by the same route 1.0 ml. of avianized distemper virus. Two days later, eight of the ten ferrets received an additional injection of 1.0 ml. vaccine, and again two days later six of the eight ferrets received another 1.0 ml. dose. On every other day thereafter, two additional animals were set aside and the remaining ferrets received another dose of vaccine. Thus, one pair of infected animals received a total of five vaccine injections, the second pair four, the third three, and so on. The normal control animals received no vaccine at all following infection with virulent virus. The results of this experiment are shown in table 1.

**TABLE 1. Administration of Avianized Distemper Vaccine Following Infection of Ferrets With Virulent Distemper Virus**

| Ferret number | Number of vaccine injections* and days following virulent virus inoculation 0 | 2 | 4 | 6 | 8 | Results |
|---|---|---|---|---|---|---|
| E 295 | x | | | | | Died of distemper 10th day |
| E 296 | x | | | | | Died of distemper 10th day |
| E 297 | x | x | | | | Died of distemper 13th day |
| E 298 | x | x | | | | Complete symptoms; sacrificed 10th day |
| E 299 | x | x | x | | | Died of distemper 9th day |
| E 300 | x | x | x | | | Died of distemper 16th day |
| E 301 | x | x | x | x | | Complete symptoms; sacrificed 9th day |
| E 302 | x | x | x | x | | Died of distemper 11th day |
| E 303 | x | x | x | x | x | Died of distemper 9th day |
| E 304 | x | x | x | x | x | Complete symptoms; sacrificed 9th day |
| E 305 | None: controls | | | | | Died of distemper 9th day |
| E 306 | None: controls | | | | | Died of distemper 10th day |

*Dose—1.0 ml. intraperitoneally

It can be seen that either single or repeated injections of vaccine following infection failed to protect or even prolong the survival time of these animals. Both treated and control ferrets became ill and either died of distemper or were sacrificed *in extremis* between the ninth and sixteenth day following the infective dose of virulent virus. In the conditions of this experiment, no interference or cell blockade was observed when a virulent distemper virus and avianized distemper vaccine were given simultaneously. Infected and treated animals presented the same clinical course of the disease as control ferrets which received virulent virus only.

2. *Onset of immunity to distemper following a single injection of avianized vaccine.* On August 23, 1951, a total of 18 distemper-susceptible ferrets each received intraperitoneally, 1.0 ml. of the reconstituted vaccine. In addition, two normal ferrets were left unvaccinated to serve as controls. On the same day, two vaccinated ferrets received 1.0 ml. challenge virus by the same route, and only a few minutes following the vaccine. Beginning the next day, and every two or three days thereafter, two other vaccinated animals were inoculated with the same dose of challenge virus. On the 16th day, together with the two remaining vaccinated animals, the two normal controls also received the challenge dose of virulent virus. The results of this experiment

*Canine distemper virus (modified) avianized (chick embryo origin-vacuum-dried) produced by Lederle Laboratories, Pearl River, N. Y.

**m.l.d.—minimum lethal dose.

are summarized in table 2. As can be seen, none of the 16 vaccinated ferrets showed any signs of distemper and they all survived beyond 30 days when the challenge dose of virus was administered one or more days following vaccination. In contrast, the normal control ferrets and the two animals vaccinated and challenged on the same day, contracted the disease and died within the expected time.

The results seemed surprising at first and could have been subject to criticism inasmuch as normal control ferrets were not included with each challenge of vaccinated animals. Part of this experiment was therefore repeated, using the same vaccine preparation and only one- and three-day challenge intervals. This time, a pair of normal control ferrets received the challenge virus along with each pair of vaccinated animals. The results of this second experiment are also given in table 2. They were essentially the same as those obtained in the first experiment except that one of the two ferrets which were challenged one day after vaccination developed distemper and died. However, both the onset of the disease and the time of death in this animal were substantially delayed. The second ferret and the two animals challenged three days after vaccination survived beyond 30 days without showing any signs of the disease, whereas all control ferrets sickened and died as expected.

**TABLE 2. Onset of Immunity to Distemper in Ferrets Following a Single Injection of Avianized Distemper Vaccine**

| Exper. No. | Ferret No. | Vac. Status | Days Before Challenge | Results of Challenge |
|---|---|---|---|---|
| 1 | 1 | | | Died of distemper |
| | 2 | | 0 | 10th day |
| | 3 | | | |
| | 4 | | 1 | |
| | 5 | | | |
| | 6 | | 3 | |
| | 7 | | | |
| | 8 | | 5 | |
| | 9 | Vaccinated | | Survived beyond |
| | 10 | | 7 | 30 days |
| | 11 | | | |
| | 12 | | 9 | |
| | 13 | | | |
| | 14 | | 12 | |
| | 15 | | | |
| | 16 | | 14 | |
| | 17 | | | |
| | 18 | | 16 | |
| | 19 | | | Died of distemper |
| | 20 | Not Vaccinated | 16 | 14th day<br>Died of distemper 15th day |
| 2 | 21 | | | Symptoms of distemper 14th day; died 21st day |
| | 22 | Vaccinated | 1 | Survived beyond 30 days |
| | 23 | Not | | Symptoms of dis- |
| | 24 | Vaccinated | 1 | temper 9th day; died 14th day |
| | 25 | Vaccinated | | Survived beyond |
| | 26 | | 3 | 30 days |
| | 27 | Not | | Symptoms of dis- |
| | 28 | Vaccinated | 3 | temper 8th day; died 12th day |

3. *Duration of immunity following a single injection of avianized distemper vaccine.* On September 15, 1950, 40 normal, distemper-susceptible ferrets were each given intraperitoneally, a single 1.0 ml. injection of avianized distemper vaccine. These ferrets were placed in quarters far removed from any infected area and their resistance to distemper was periodically tested by challenging a certain number of them with virulent ferret-origin virus. Normal controls were included each time vaccinated animals were challenged. The schedule and results of these inoculations are given in table 3.

It is apparent that a single injection of avianized vaccine protects susceptible ferrets for at least two years. However, because of some deaths among the original 40 ferrets from intercurrent infections other than distemper, the number challenged each time has had to be slightly decreased. The challenge of the remaining vaccinated animals will be continued periodically for one or two more years.

## Discussion

The experiments reported above clearly indicate that a single administration to susceptible ferrets of avianized distemper vaccine solidly protects them against a severe challenge dose of virulent distemper virus within 24 to 72 hours. Interference of the modified virus with the establishment of infection rather than actual immunity, seems to be a logical explanation for the resistance of animals so soon after vaccination.

These experiments also seem to show that avianized vaccine is ineffective as a therapeutic agent even when its repeated administration is started simultaneously with inoculation of virulent virus. The latter observation is in contradiction to the results reported in the treatment of clinical distemper of the dog with a ferret-adapted and so-called modified virus[12]. They seem to confirm, however, the view of the present authors that a virulent viral agent will always have "priority" over a homologous modified virus when the two are injected si-

multaneously. In contrast, when the modified virus is administered as little as 24 hours before infection with virulent virus it seems to become sufficiently well established in the susceptible tissues of the animal to prevent the virulent agent from causing disease and death*. The duration of immunity observed following the single dose of vaccine also supports the belief of the authors that a live modified virus vaccine will produce an immunity of much longer duration than a killed vaccine. The complete innocuity of the modified distemper vaccine may also be observed by the lack of untoward reaction of any kind in the susceptible animal. Although no therapeutic value was demonstrated for avianized distemper vaccine, it may be concluded that it presents all the requisites of an ideal immunizing agent: safety upon administration, rapid establishment of resistance, and long duration of immunity.

## Summary


1. The administration of avianized distemper vaccine to ferrets immediately following infection with virulent virus afforded no therapeutic action on the course of the experimental disease.

2. Ferrets receiving a single injection of avianized distemper vaccine were found to be resistant to infection after as short an interval as 24 to 72 hours.

3. A single injection of avianized distemper vaccine was demonstrated solidly to protect susceptible animals for at least two years.


**TABLE 3. Duration of Immunity Against Distemper in Ferrets Following a Single Injection of Avianized Distemper Vaccine**

| Date of Challenge | Int. bet. Vac. and Chall. | No. of Animals Challenged | Results |
|---|---|---|---|
| 12/15/50 | 3 months | 5 vaccinated | Survived beyond 21 days |
| | | 2 controls | Died of distemper 12th day |
| 3/15/51 | 6 months | 4 vaccinated | Survived beyond 21 days |
| | | 2 controls | Died of distemper 12th and 13th day |
| 6/15/51 | 9 months | 3 vaccinated | Survived beyond 21 days |
| | | 2 controls | Died of distemper 12th and 13th day |
| 9/20/51 | 1 year | 3 vaccinated | Survived beyond 21 days |
| | | 2 controls | Died of distemper 12th and 13th day |
| 1/17/52 | 16 months | 2 vaccinated | Survived beyond 21 days |
| | | 2 controls | Died of distemper 14th day |
| 9/9/52 | 2 years | 2 vaccinated | Survived beyond 21 days |
| | | 2 controls | Died of distemper 12th and 14th day |

*After the completion of our work, Baker and coworkers have reported similar observations with the Onderstepoort strain of chick embryo adapted distemper virus (Baker, G. A., Leader, R. W., and Gorham, J. R. Immune Response of Ferrets to Vaccination with Egg-adapted Distemper Virus. 1. Time of Development of Resistance to Virulent Distemper Virus. *Vet. Med.*, 47:463 (Nov.), 1952.

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Canine spermatozoa are short-lived by comparison with those of other species. Twenty-one hours appears to be a fair estimate of the longest time motility will continue *in vitro*.—*Fred J. Kingma, D.V.M.*

# Blood Substitutes Or Plasma Extenders For Small Animal Practice*

STANLEY G. PENNY, D.V.M., Brooklyn, New York

THE basic use of plasma, plasma extenders, and blood is in hemorrhagic and traumatic shock. During World War II, and since, a great deal of time and money have been spent on experimental work in this field. The following findings may have application in your practice when hemorrhagic and traumatic shock are problems.

Sudden reduction in blood volume is the usual cause of shock. This in turn initiates a vicious cycle: decrease in cardiac output; vasoconstriction; liberation of a vasoexcitor material from the adrenals, kidneys, and the sympathetic nervous system; anoxemia, which results in generalized tissue anoxia; renal failure; pooling and trapping of blood in the capillary bed; liberation of a vasodepressor material from the liver and the skeletal muscle; acidosis; and finally death.

Shock may be divided into reversible and irreversible shock.

Complete recovery from blood loss without treatment is reversible hemorrhagic shock. The average blood volume in the dog is 97 cc. per kg.[1] (2.2 lb.); in the cat it is 70 cc. per kg. of body weight[4]. The maximum blood loss that a dog can sustain and make up without intervention is 38 cc. per kg.[1,2,3]. If the dog loses more than 39 cc./kg. it will be in shock (40 mm. Hg.) and must be transfused within 60 minutes to live[3].

Hemorrhage severe enough to keep the blood pressure below 40 mm. Hg. for a period of 90 minutes will kill the dog regardless of treatment and is obviously irreversible shock.

Dogs in traumatic shock (muscle trauma) seldom survive with a residual blood volume of less than 73 cc./kg. of body weight[1]. The reason why such a small blood loss in traumatic shock will cause death is because there is prompt central nervous system depression[5,6]. If sublethal hemorrhage is combined with stimulation of the sciatic nerve, the clinical picture is that of traumatic shock[7]. If the sensory part of the spinal cord is cut, or if anesthesia is maintained by means of procaine in the spinal cord and the hind legs traumatized, the dog can stand a blood loss of 33 cc./kg. which is very close to simple hemorrhagic shock[8].

Clinical symptoms of shock are common knowledge of the practitioner. Most veterinarians do not pay too much attention to the heart rate. In both hemorrhagic and traumatic shock, the heart rate is between 200 and 240 per minute[2,3,9]. As the degree of shock progresses, the heart beat can be heard more distinctly and the force with which the apex is thrust against the chest wall is greater. Wiggers[9] states that 30 minutes after infusion of blood the heart rate should slowly return to normal, or at least below 150 heart beats a minute. Another prognostic sign is urinary secretion. According to Gregersen,[11] dogs in which tranfusion effected permanent recovery produced a greater urine flow than did those which died within 24 hours. Dogs that lived after transfusion produced, on the average, 55 cc. of urine; those that died produced, on the average, 17 cc. of urine in the first hour. The passage of bloody fluid feces[3] is a sign of irreversible shock; on postmortem, one will find submucosal and mucosal hemorrhages in the upper third of the small intestine and in the lower colon.

## Blood for Transfusion

Blood may be taken from the heart or the jugular vein. One of the difficulties encountered in collecting blood is clot in the needle or tubing. This problem can be overcome by heparinizing the donor. Ten minutes before drawing blood, heparin is injected intravenously at a dose of 1 mg. per kg. of body weight[12]. The donor's coagulation time will return to normal in one and one-half hours. This is done routinely now in all collections of blood, regardless of method.

There are two types of flasks used in the collection of blood, one is a vacuum type, and the other dependent on a gravity feed system. The Baxter vacuum flasks collecting units are preferred; tubing appears to be of a sufficiently heavy gauge so that it does not collapse.

*Presented at the 61st annual convention of the New York State Veterinary Medical Society, Lake George, September 9-12, 1952.

## Anticoagulants

There are three types of anticoagulants commonly used: heparin, sodium citrate, and A.C.D. solution.

Heparin should be used only if the blood is to be used immediately. It will prevent clotting for one-half to one hour. Twenty mg. of heparin can be added to 500 cc. of drawn blood if the donor has not been heparinized.

Sodium citrate is administered at the rate of 50 cc. of 4% sodium citrate solution for each 500 cc. of blood. It can be stored for only six to ten days at 4 C., if it is sterile.

A.C.D. solution. Citrate solution with dextrose tends to minimize hemolysis and increases the storage time up to possibly 30 days[27]. Dextrose should be cold to prevent diffusion into red cells to avoid hemolysis[13]. It is mandatory that the flask and anticoagulant solution be chilled to the temperature of the refrigerator before adding blood. This results in more rapid and uniform cooling of the erythrocytes. There is evidence that the red cells persist in the circulation longer when they are collected in prechilled solutions. After blood is stored the criterion as to whether the blood is too old for use is based on the survival of the red cells in the circulation of the recipient. This can be judged on the amount of spontaneous hemolysis in the flask. Experience makes it possible to determine the amount of free hemoglobin (red color) by simple inspection. Based on recent experimental work,[24] hemolized blood will not cause nephrosis. The major portion of it is excreted in the urine. To a small degree, hemolized blood supplies nitrogen and iron to the body.

The use of disposable units for collection and administration is important because they are time- and labor-saving and free of pyrogens. Pyrogenic reactions may be due to foreign material, dead bacteria, and end products of certain species of bacterial growth. Parenteral fluids containing pyrogens cause chills and increased temperature which may last for two to eight hours.

## Method of Injection — Intravenous

The maximum rate for administration of blood varies with the need; the greater the loss of blood, the more rapid the rate. Normally there are two factors involved with rate of transfusion: (1) cardiac failure, and (2) sodium citrate poisoning. Kohlstaedt and Page[14] determined the maximum rate to be between 7 cc. and 14 cc. per minute. Rates above this would cause a sharp rise in intrathoracic pressure and signal impending cardiac failure. Adams[15] recommends that not more than 0.12 to 0.25 gm./kg. body weight of sodium citrate be used when replacing 60% of the total blood volume with citrated blood. To be safely tolerated, the rate of administration of this amount of citrated blood should be from 20 to 35 minutes. With increased rate and increased concentration of sodium citrate, calcium must be given intravenously. The amount of calcium usually employed in dogs weighing seven to 14 kg. was 4 gm. or 20 cc. of a 20% solution of calcium gluconate. This should be injected separately and obviously not added to the citrated blood. The symptoms of citrate overdose are: falling blood pressure, increased respiration, tetanic contractions or fibrillary twitching of muscles, sluggish eye reflexes, and very dark blood. Normally the citrate radical is rapidly oxidized and excreted from the body.

The best treatment of shock is prevention. The question is: When is the best time to give fluids, before or during an operation? A group of dogs was given 15% of their total plasma volume at a set time before they were bled into hemorrhagic shock. This work was done by the Levinson group in 1947[16]. The results were as follows:

The greatest survival rate followed the administration of gelatin five minutes before hemorrhage. Saline given two hours before hemorrhage seemed to do more harm than good.

Price's group,[17] in determining the effect and fate of blood transfused in normal dogs, found that blood given to normal nonhydrated dogs did not effectively increase the blood volume for more than five hours, the plasma volume for more than two hours, or the total protein mass for more than three hours. To get the maximum effect from a blood or a plasma substitute the best time to start the administration is during operation[18].

Swingle and Kleinberg[19] determined the value of plasma, gelatin, and saline therapy in experimental wound shock. The procedure used for producing shock was gunshot injury to muscles of the hind limbs of deeply anesthetized dogs. The greater effectiveness of small intermittent infusions over single massive injections presumably is due to greater retention of plasma within the circulation. The volume given at each intermittent injection is not sufficient to raise the pressure appreciably or force the plasma through the injured vessels into the tissues at the site of injury. On the other hand, the plasma given as a single massive infusion rapidly leaks into the tissues of the limb causing marked swelling and starting bleeding anew. The results of this experiment

can be applied clinically by the veterinarian with the use of the Kingma infusion tube which makes possible the administration of fluids over a long period of time.

### Intramedullary Infusion of Fluid

This method is useful only when the intravenous route is not available, as in poor, obliterated, or collapsed veins, extensive burns, or in very young animals.

Tocantins,[21] in 1940, adapted the intramedullary method for introducing fluid quickly into the circulation. The administered fluid finds its way into veins of the cortex of the bone. The rate of injection is 0.4 to 7 cc. per minute. His original work was done with rabbits. A needle was inserted into the tibia and another needle into the heart. 1.5 cc. of a 1% congo red solution was injected into the tibia. Blood was removed from the heart post-injection at 10, 20, and 60 seconds, and then centrifuged and the plasma checked for the dye. The dye was found in the first specimen, indicating that it took ten seconds or less to reach the heart.

### Intra-Arterial Transfusion

Intra-arterial transfusion is used only as a resuscitation method in acute shock, where time is a factor. It is based on the principle of giving blood, or a fluid such as gelatin, under pressure greater than that of the mean arterial blood pressure, to permit entry of the blood or fluid into the arterial system. In 1948, Page and Glasser[22] subjected 39 animals to hemorrhagic shock until breathing had stopped for an average of two to eight minutes, and the heart had stopped beating for two minutes. Intra-arterial transfusion of blood resuscitated 84% of the animals; 33% of these lived indefinitely, 51% lived for an average of ten hours.

Kohlstaedt and Page,[14] in their work on dogs, demonstrated that the recovery rate in deep hemorrhagic shock was 75% with intra-arterial and 30% with intravenous transfusion. Robertson[24] has also shown that intra-arterial transfusion produced results four times faster than intravenous.

The easiest place to give an intra-arterial tranfusion in a dog is the femoral artery[20,23,26]. It is just under the skin on the medial surface of the thigh and one can always pick up even a weak pulse at this point to serve as a guide. If necessary, one can cut down on the artery. The pressure in the blood bottle is started at 50 mm. of Hg., assuming that the animal is in deep shock (30-40 mm. Hg.). If the animal's pressure becomes equal to the pressure in the bottle, the blood in the drip tube will stop flowing. The pressure in the bottle should be about 20 mm. of Hg. above the patient's recorded pressure. The rate of flow should be about 50 to 100 cc. per minute. Dogs in shock return to normal in four to seven minutes, whereas in intravenous transfusion it takes 30 to 40 minutes. The return to normal with intra-arterial tranfusion is dramatic. There are many reasons[24,26] why this form of administration should be practiced: (1) The intra-aortic pressure is built up very fast, thus overcoming vasoconstriction and allowing the capillary bed to receive fresh blood, and terminating tissue anoxia. (2) The coronary arteries are perfused, thus relieving the myocardial ischemia, which, according to Page,[22] is probably the basic cause of cardiac dilation in terminal shock. (3) If at the point of respiratory arrest, the patient will suddenly gasp and normal respiration will appear. Jones[24] and his group proved that this was due to the rapid replacement of the static and deoxygenated blood in the capillaries of the brain, through the vertebral arteries. (4) The urine flow starts in 90 seconds; if the blood pressure stays below 70 mm. of Hg. for more than 40 minutes, irreversible changes may occur in the kidney. (5) 50% less blood is required to bring the dog back to normal with intra-arterial transfusion than is required with intravenous transfusion. (6) If internal bleeding from the spleen, liver or kidney has occurred, arterial pressure will fall off rapidly; one is thus able to detect bleeding within minutes rather than hours. Do not use saline solution for intra-arterial transfusion as it will not maintain blood pressure. Page's dogs died within two hours after saline intra-arterial transfusion.

### Plasma Extenders

In order that a substance be acceptable as a plasma or blood substitute, there are certain fundamentals that must be fulfilled. Its osmotic pressure and viscosity should approximate those of plasma. It must be capable of increasing the blood pressure and circulating volume, and maintaining it until the body recovers from shock. If the blood loss is excessive, plasma extenders must be capable of supporting the circulation until a transfusion can be given. The molecular weight must approach that of the plasma protein—62,000. It should be chemically indifferent and should leave the body in a few days after administration. It must be sterile, pure, uniform, stable,

and be available in large quantities at low cost.

Plasma extenders considered here are gelatins, P.V.P., dextran, globin, pectin, and ascitic fluid.

## Gelatin

Gelatin is an animal protein obtained by boiling various connective tissues so that they are broken down into amino acids, polypeptides, and protein molecules. It lacks two of the essential amino acids. There are four types of gelatins. Three are commercially available: plasmoid®, oxypolygelatin, and pig skin or hide gelatin. Isinglass or fish gelatin, infrequently available, is prepared from the sounds or swimming bladders of sturgeon, hake, and sea trout. As it is now prepared, it is mildly pyrogenic[18]. In order to make the natural gelatin molecule as close as possible to the serum albumin molecule it must be autoclaved or degraded. In this process, the larger molecules are broken down. The longer the period of autoclaving, the smaller molecules become[18,37].

The long molecules are responsible for high viscosity, the slow rate of excretion into the urine, increased sedimentation rate of red cells, and geling at room temperature.

Plasmoid, which is an example of a long molecule (45,000), has high viscosity and a slow rate of excretion into the urine—80% in 48 hours[20,51]. It does not gel at room temperature. It is made from beef bone.

Hide gelatin, which is an example of a small molecule (20,000), is excreted into the urine in 12 hours[21,38]. It does not maintain blood pressure as well as the bone gelatin due to its rapid rate of excretion.

Oxypolygelatin is prepared by modifying gelatin with chemical agents such as glyoxal and hydrogen peroxide[33]. Bone and pigskin are used in its preparation. Thirty-nine percent of oxypolygelatin is excreted into the urine in 24 hours. It has a molecular weight of 40,000.

All three gelatins are nontoxic, nonantigenic, and nonpyrogenic. They all increase sedimentation rate of red cells and produce pseudoagglutination of red cells[34,35]. According to Hartman,[36] there is acute transient retention of gelatin in the epithelium of the convoluted tubules of the kidney, producing nephrosis; yet chronic storage is not observed. Refuting this is the work done by Vars group at the Harrison School of Research at the University of Pennsylvania[37] who gave bone gelatin for 112 days to dogs without producing kidney changes. Originally, thrombi were produced in the blood vessels where the gelatin was injected. It has been determined that this was caused by the preservatives in the solution and has now been rectified. Once a bottle of plasmoid is opened it should be completely used. One can not save a portion of it for further use the next day, as it is apt to be contaminated.

## Polyvinylpyrrolidone

Polyvinylpyrrolidone (P.V.P.)[38] was developed in late 1930 by Dr. Walter Reppe and his associates in the research laboratories of I. G. Farben. He developed a technic for safely handling acetylene under pressure. Basically this process consists of combining formaldehyde and acetylene as raw materials; then polymerization of N-vinylpyrrolidone to form P.V.P. It has a molecular weight ranging from 40,000 to 50,000. It is now used in a 3.5% solution in saline.

The dog is the only animal that is sensitive to P.V.P. The degree of reaction varies with the investigator, whether anesthesia is used, the type of experiment that is being done, and the amount of the drug injected. The symptoms are[39,40]: excitement, flushing, urticaria, itching, increased respiration, vomiting, bloody diarrhea, gas formation, hypotension with vascular collapse, paralysis of the hind legs, and coma. Various investigators claim that they can desensitize the dog; others claim they can not. The desensitizing dose[38] is 2-3 cc./kg. given in two separate injections within 24 hours.

P.V.P. remains in the blood for from 12 hours to two days, in sufficient concentration to support the circulation. The lower molecular fraction is excreted into the urine in the first 24 hours[41]. This represents 20-25%. Twenty-four hours after infusion, the concentration in the blood is less than one-half. It falls off slowly thereafter and can not be detected in the blood or organs after three or four weeks. Only 50% of P.V.P. is eliminated in the urine. It is stored in the lymph nodes, spleen, liver, kidneys, and the reticuloendothelial cells[39]. One of its important assets, in addition to its use in circulatory shock, is its versatile binding power and kidney excretability[42]. It has been definitely shown, with acid diazo dyes, that serum cleaning can be accomplished and dyes can be removed from within the cell itself. Nonexcretable dye which had already been deposited within rabbits' tissue was returned to the vascular system after intravenous P.V.P. and excreted into

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the urine. Guinea pigs given overdoses of sodium luminal survived and showed shorter sleeping periods. P.V.P. has a detoxifying action against diphtheria, tetanus, and botulinus toxins[42]. Diphtheria mortality rate was decreased from 46% to 23%, and paralysis was reduced from 90% to 25% by the use of this agent. P.V.P. works well in cats[38]. It has been used in hemorrhagic shock with good results.

### Dextran

Dextran is a polymer of glucose which was developed in Sweden in 1943[43]. Like gelatin its molecular weight can be changed by autoclaving or degradation. Its average molecular weight varies around 72,000. It is a chemical produced by bacterial fermentation of sugar or saccharose. In fact, for years it has been known in the wine and sugar industries as "spoiled" sugar. It is prepared commercially by dialysis from solutions of fermented saccharose purified by repeated precipitation with alcohol. It was released to the general medical practice in 1947 in Sweden and since then has undergone extensive trials without injurious results. It is now undergoing tests in this country. There are species sensitivities or idiosyncrasies. In rats[44] and in men who have had bacterial diseases such as pneumococcal pneumonia or nonhemolytic streptococcic infection, reactions[45] have occurred. In the dog, it works very well. In fact, the various groups of research workers in this country class it as the best artificial replacement fluid for dogs[31,46]. There is now evidence that dextran is not stored but burned in the body like other sugars and starches. This has been discovered through radioactive experiments. In a 6% solution of physiological saline its viscosity and colloid osmotic pressure are similar to those of plasma. About 50% of the infused material is metabolized in the body like other starches and sugars. It causes an increase in sedimentation and a tendency toward pseudoagglutination of red cells.

Scudder[45] in the work on dextran in which 42% of the blood volume of dogs was taken and replaced with 400 to 500 cc. of dextran, states, "the clinical response of the dogs to the infusion was quite dramatic". The dogs were sacrificed between the fifth and 19th days. The tissues were grossly normal; microscopically the spleen showed evidence of moderate reticuloendothelial hyperplasia, the liver of some of the dogs showed evidence of focal midzone necrosis, the kidneys showed various degrees of focal glomerular and tubular damage; however, less than 10% of the kidney was involved. Other research workers here and in Sweden[43] did not observe such pathology. Others have found similar changes with other substitutes.

### Globin

Globin is one of the plasma extenders that is in the trial period in human medicine[47]. Globin[53,54] is made from the red cells usually discarded in the production of plasma. The red cells in 500 cc. of blood will make 50 gm. of modified globin. This could be an excellent use for red cells remaining after the production of distemper serum by veterinary biological producers. The process consists in the removal of the pigment heme from the protein, then precipitating the protein, washing with acetone and heating with a solution of sodium hydroxide. This modified globin corrects lost blood volume, and maintains the patient in positive nitrogen balance by feeding protein intravenously. Human globin is not compatible in the dog[31].

### Ascitic Fluid

Ascitic fluid was first used in this country in 1938 when Davis and White[48] collected fluids obtained from human patients with cardiac decompensation or portal cirrhosis, and injected it into dogs which were in experimental shock produced by graded hemorrhage. The animals survived with no ill effects. It can be stored in a refrigerator as long as five months without preservatives. Maes and Davis[49] used it in 20 human transfusions with good results.

### Pectin

Pectin is a colloidal carbohydrate of molecular weight approximating 55,000, and rather complex composition[50]. It is made from pure citrus pectin supplied by the California Fruit Growers' Exchange. It is prepared by autoclaving or degrading. The pH must be adjusted between 7.2 and 7.4 and it is used as a 0.5% solution. Like other extenders, it causes pseudoagglutination of the red cells. Most investigators[50] claim it is deposited and stored in the liver, kidney, and reticuloendothelial cells of the body.

### Conclusion

In conclusion, the best treatment for hemorrhagic and traumatic shock is blood transfusion using direct donors or collected blood. But, for those who do not maintain blood banks, the next best procedure is the use of

plasma extenders. In my opinion, the best plasma extender for dogs is dextran; second, plasmoid, and third, oxypolygelatin. This rating of products[39,51,46,50,51,53] is based on their ability to maintain blood volume and on their slow rate of excretion into the urine.

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## Veterinary Uses of Pituitrin

Pituitrin, derived from the posterior lobe of the pituitary gland, causes uterine contraction. Judicious use of this hormone when the cervix is relaxed may assist in expelling retained placenta, mummified fetuses, or cause the expulsion of the fetus. It has been used successfully to complete the farrowing process.

Pituitrin stimulates the "let-down" of milk. It has been helpful in aiding piglets get their first nursing and start regular "let-down" of milk in sows.

Cows do not always "let-down" milk completely due to a hormone deficiency. Intravenous injection of 10 I.U. of pituitrin before each regular milking may increase milk production as much as five to ten pounds daily. —*C. W. Turner, Ph.D.*

# EDITORIAL COMMENTS

## Trichomonads Associated with Atrophic Rhinitis

Following investigation to determine the etiology of atrophic rhinitis in swine, Switzer reported (*Vet. Med.*, 46:478 [Dec.], 1951) that trichomonads were observed in a large percentage of infected animals.

In his annual report, Dr. B. T. Simms, chief of the BAI, refers to the examination of 59 hogs believed to be affected with this disease. On the basis of lesions found in the nasal cavaties, 27 of these pigs were considered to be victims of the disease. All 27 were found to harbor trichomonads. Four of the remaining 32 pigs which did not exhibit gross lesions also harbored trichomonads.

Although available evidence is not conclusive, trichomonads have been demonstrated regularly in the nasal cavities of pigs from affected droves. One must also be mindful that failure to demonstrate these parasites by direct smear cannot be interpreted to mean that they are absent. The organisms are difficult to demonstrate by this technic alone.

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## Bovine Blood Bank Established at Colorado

It is anticipated that veterinarians in the Rocky Mountain region will be able soon to procure whole blood for indirect transfusion if present plans materialize as expected.

Dr. Joseph Ruwitch, who recently joined the staff of the School of Veterinary Medicine, Colorado A. & M. College, Fort Collins, is guiding the new venture. Blood is collected from healthy animals in liter flasks to which standard A.C.D. solution has been added as an anticoagulant. Cultures are made every second day while the blood is stored. Thus far, seven-day-old whole blood has been used successfully. Doctor Ruwitch believes that a storage period of 18 to 21 days is possible by present methods.

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A disease of cattle which has existed in California for several years and described as idiophatic hemoglobinuria has been determined to be leptospirosis. Numerous *Leptospira pomona* organisms were identified by a new staining technic of kidney sections.—*Annual Rept., San Diego Livestock Depart.*

## Expeller and Solvent Oil Meals

It has been known for many years that young animals utilized heat-treated soybeans more efficiently than raw beans. It was formerly believed that raw beans were too high in fat and that best feeding results were due to removal of oil. Later work suggested that essential amino acids were absent or not available to growing animals. Still other work has suggested toxic substances that were otherwise harmful.

Two general methods have been used for producing feeding meal from soybeans, (1) the expeller process and (2) the solvent process. In the first, beans are heated to an optimum temperature and then subjected to pressure for removal of oil. Resulting meals contain approximately 5% fat. These have been in favor for dairy cattle and other ruminants.

The solvent process makes use of fat solvent and the petroleum product hexane has been used by some manufacturers in the United States. The less inflammable trichlorethylene used in Europe some years ago also appeared to meet specification for satisfactory production of oils and meal. Since such meals have proved toxic to cattle as determined by research at Kansas, Minnesota, and Iowa, most of the plants using trichlorethylene have discontinued operations. The exact cause of toxicity has not been determined.

Feeders must depend to a large extent on vegetable oil meals for a large share of the protein supply needed by livestock. Oil meals have certain well known limitations, but they can satisfactorily replace some of the animal by-products formerly used as the main source of supplementary protein feed. — *Nutrition News Bul.*

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In spite of the use of anthelmintics having higher efficacy than those previously used, ascarid infection among swine has increased throughout the hog belt during most recent years.—*J. D. Ray, D.V.M.*

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Share of the cost for indemnity payments to owners of swine affected with vesicular exanthema by the state of Illinois covering the period of outbreaks during the summer and fall of 1952 was $184,000.—*Roy A. Thompson, D.V.M.*

## Officials Meet to Discuss Vesicular Exanthema

An advisory committee composed of representatives of swine breeders and feeders, farm organizations, livestock marketing, transporting, and packing groups, as well as state and national livestock sanitary officials, met recently in Chicago with Under-Secretary True D. Morse to discuss measures for control of vesicular exanthema in swine.

A report of the situation revealed that this disease has appeared in parts of 36 states since the outbreak in July 1952, and that 22 states are now involved in quarantines. Recent amendment to BAI order 383 imposes restrictions of federal quarantines on parts of Florida, North Carolina, and Wisconsin where disease outbreaks have occurred for the first time.

Information was given that five states have enacted legislation preventing the feeding of raw garbage to swine and that similar bills have been introduced in 23 states. Thirteen more are reported to be in the process of preparing legislation for introduction. The fact that cooking garbage prior to feeding was "essential for the ultimate eradication of vesicular exanthema" was reaffirmed. Every effort possible was recommended to assist and encourage individual states to enact appropriate legislation.

Similarity of vesicular exanthema to foot-and-mouth disease is the greatest hazard of its continued existence. Adequate cooking of garbage *is the principle specific measure* that may be expected to break the cycle of infection, usually traceable to the feeding of raw garbage and packing-house offal.

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## Trichinosis Conference Recommends Legislation Prohibiting Raw Garbage Feeding

National Conference on Trichinosis, held in Chicago in December 1952, recommended that all states pass laws promptly prohibiting the feeding of uncooked garbage and offal. Also recommended was that those who sterilize garbage by approved cooking methods be licensed and inspected to assure that proper cooking standards are maintained.

Suggested for further study was the imposition of federal quarantine on a statewide basis by 1955, which would prohibit the movement of live hogs, dressed pork, or pork products in interstate commerce in those states not having legislation in force requiring the cooking of raw garbage before it is fed to swine, other livestock, or poultry.

Concern with matters pertaining to the incidence of trichinae in the United States motivated this conference. It was brought out that autopsy covering surveys of 10,000 persons indicated that 16% were infected with trichinae. This and other studies have established the appalling fact that the incidence of this disease in the United States is higher than any other country in the world. It was suggested that if examinations were more thorough, the incidence rate would have been nearly 30%.

The most important source of infection in man is by way of insufficiently cooked pork products; the main factor in infecting swine is by way of feeding raw garbage.

Other diseases that may be transmitted to swine and some which are communicable to man may also be carried by way of raw garbage feeding. Among those mentioned was vesicular exanthema and hog cholera, which attack only swine; foot-and-mouth disease, tuberculosis, and other diseases which attack other animals and man. Experience in Canada was cited. Raw garbage feeding has been outlawed in that country for years; trichinae infected pork, vesicular exanthema, and hog cholera are practically unknown there.—*Abstract of report of Mr. A. D. Moore.*

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## Treatment of Bloat in Cattle

Treatment of bloat in cattle should be directed toward relieving distension by tapping off accumulated gases by way of the stomach tube or trocar. Toxemia should be treated by injection of dextrose and calcium gluconate. Rumen contraction may be re-established by lentin administered hypodermically and digestion stimulated by ruminatorics such as tartar emetic. *C. E. Whiteman, D.V.M.*

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Three of the top ten agricultural news stories for 1952 were those concerning livestock diseases. A nation-wide panel nominated 60 outstanding farm stories. Among the ten articles of farmer interest most often mentioned were those relating to foot-and-mouth disease, vesicular exanthema, and anthrax.

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## Facility Development Program at Illinois

The first building in the facility development program of the University of Illinois, College of Veterinary Medicine, was completed in January 1952. This modern, four-story building houses the departments of veterinary pathology and hygiene, physiology and pharmacology, and anatomy and histology. Included in the building are three classrooms, six teaching laboratories, an auditorium seating 277 persons, a museum, a library, animal rooms, administration offices, and research laboratories. In addition, an annex houses other research activities.

A request for a second major building, the large animal unit of the veterinary clinic, has been approved by the Board of Trustees for presentation to the legislature now in session. A small-animal-clinic unit is also planned for the future. At the present time, the Department of Veterinary Clinical Medicine is temporarily housed in the building formerly known as the Veterinary Pathology Laboratory.

## Joins Editorial Staff

Dr. Kenneth B. Haas, Jr., for the past four years associated with Dr. Olof Norling-Christensen, Chicago, Ill., has joined the editorial staff of VETERINARY MEDICINE.

Dr. Kenneth B. Haas, Jr.

A native of Pennsylvania, Doctor Haas attended Georgetown University, Washington, D. C., for his pre-veterinary work, and the Ohio State University, College of Veterinary Medicine, Columbus, where he received his doctorate in 1949.

Doctor Haas has contributed to the veterinary literature from time to time, and has recently co-authored the book Business Practices In Veterinary Medicine with his father, Dr. Kenneth B. Haas, Sr. He has been active in the local and state associations. He is married and p'ans to make his home in Kansas City.

The first new unit in the facility development program for the College of Veterinary Medicine, University of Illinois, Urbana, is now occupied.

## A.A.H.A. Meeting Plans Complete

President Myron A. Thom, Pasadena, Calif., with the assistance of Program Chairman George W. Mather, School of Veterinary Medicine, University of Minnesota, St. Paul, has completed preliminary arrangements for

Dr. Myron A. Thom

the program of the American Animal Hospital Association's annual meeting to be held at the Hotel Radisson, Minneapolis, Minn., May 6-9, 1953.

Through the courtesy of Pitman-Moore Company and Radio Corporation of America, three half-day sessions of televised clinical demonstrations are planned which will feature the surgical section of the program. The television studios will be set up at the university veterinary clinic and the program will be relayed to the auditorium of the Hotel Radisson.

All veterinarians interested in small animal medicine are cordially invited to participate in the meeting. Those desiring hotel reservations, cards, or a copy of the program, may obtain them by writing to the American Animal Hospital Association, Office of the Secretary, Wayne H. Riser, 5335 Touhy Avenue, Skokie, Ill.

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While cattle numbers reached an all-time high in January 1953, hogs dropped 14% and chickens 4% from figures reported for January 1952. Horses and mules continued their 26-year decline and ewe lambs declined 21%; leaving little chance for increasing breeding flocks in 1953.

U. S. Livestock Numbers and Values—1953

| | Total Number | Total Value |
|---|---|---|
| Cattle and calves | 93,696,000 | $11,993,088,000. |
| Milk cows | 23,996,000 | $ 4,847,192,000. |
| Hogs, including pigs | 54,632,000 | $ 1,420,432,000. |
| Stock sheep and lambs | 27,857,000 | $ 445,712,000. |
| Horses and mules | 5,636,000 | $ None given |
| Chickens | 431,410,000 | $ 4,480,978,000. |
| Totals | 637,227,000 | $23,187,402,000. |

*—Doane Agr. Digest, March 1953*

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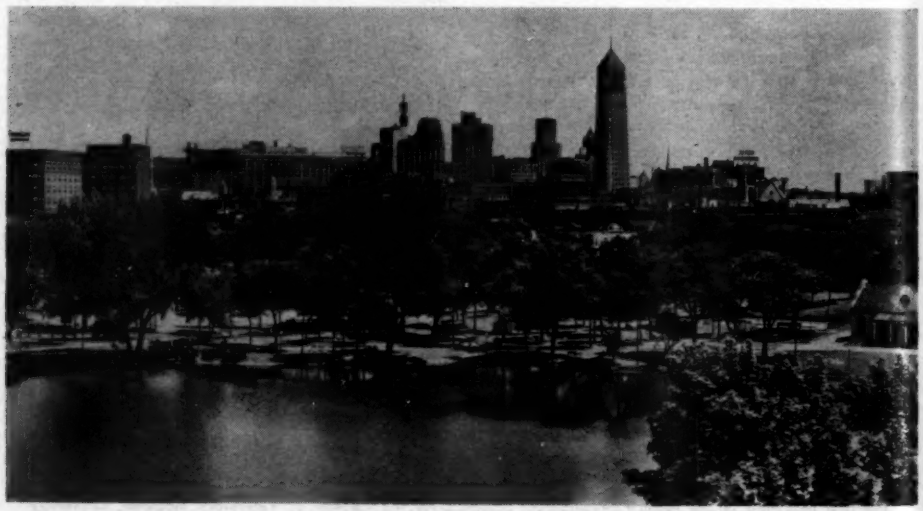
Cats are not susceptible to canine distemper, but this does not prevent them from carrying the virus from a dog to other susceptible animals.



Skyline of Minneapolis as seen from Loring Lake, one of many lakes in the vicinity of the city.

## XV. International Veterinary Congress, Stockholm, Sweden, August 9-15, 1953

Recently received is the fourth official bulletin sent out by the Organizing Committee in Stockholm with reference to the Congress to be held there next August.

Persons in the United States who will not be able to attend the Congress but who will want to obtain the official Proceedings (two volumes) may apply for associate membership. Application forms for association membership will be available later and may be used by individuals, veterinary faculties, libraries, veterinary associations, and institutions to obtain copies of the Official Proceedings of the Stockholm Congress.

Persons in the United States who expect to attend the Stockholm Congress should write the A.V.M.A., 600 S. Michigan Ave., Chicago 5, Ill., for an official application form. This form gives full information about the type of membership to be applied for, the required fees for membership and the Congress banquet, and contains an application for room or hotel reservations in Stockholm during the XV. International Veterinary Congress.

### Program Schedule

Sunday, August 9. Registration in the Congress Bureau and a reception in the Town Hall of Stockholm.

Monday, August 10. Official Opening of the Congress in the Concert Hall of Stockholm. The scientific program of the Congress will get under way on this day.

Tuesday, August 11. Scientific sessions, morning and afternoon; the Congress banquet and dance will be held in the evening.

Wednesday, August 12. Scientific sessions, morning and afternoon; a concert in the National Museum at night.

Thursday and Friday, August 13-14. Scientific sessions, morning and afternoon; visits to the Palace Theatre of Drottningholm (18th century) in the evenings for special entertainment.

Saturday, August 15. Official closing session.

### Visits to Points of Interest

In addition to the scientific sessions, visits have been planned by the Organizing Committee to the Royal Veterinary College, the State Veterinary Medical Institute, the State Bacteriological Laboratory, the National Institute of Public Health, the Royal Agricultural College, the National Animal Experiment Station, the Animal Breeding Institute and to an abattoir, a dairy, an insemination center, and representative farms.

Daily sightseeing tours by bus and boat in Stockholm and surroundings are planned. A special ladies' program including a complimentary luncheon, and visits to points of cultural, social, and historic interest will be offered.

Paris, included in official tours

Before and during the Congress, tours will be arranged according to individual wishes. After the Congress, conducted tours are planned to Malmö through South Sweden and to Gothenburg through West Sweden. Prospectuses of these tours will be sent to persons interested who so request in the membership application form.

### Sponsored Tours

A good number of reservations have already been made for the tours offered by the A.V.M.A. and the United States Committee in collaboration with the Travel Service Bureau. Persons who are interested and who want more information should write immediately to Mr. Nelson M. Jost, Travel Service Bureau, Inc., 318 Harvard St., Brookline, Mass.

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A survey conducted by Cornell University indicated that losses due to infertility in cattle in New York state is $20,000,000. annually.

## Canada Declared Free of Foot-and-Mouth Disease

Secretary of Agriculture Ezra Taft Benson has announced that foot-and-mouth disease no longer exists in Canada. Restrictions on the importation of livestock and animal or other products imposed because of the disease have been lifted, effective March 1, 1953. Secretary Benson also proclaimed an end to the state of emergency announced March 10, 1952, because of the Canadian outbreak.

Foot-and-mouth disease was officially reported February 25, 1952, from the vicinity of Regina, Saskatchewan. At that time the United States prohibited the importation of cattle, sheep, and other domestic ruminants and swine and of fresh, chilled, or frozen beef, veal, mutton, lamb, or pork. In addition, prohibitions and restrictions were placed on other susceptible animals, certain animal products, hay, straw, and materials that might possibly bring the infection into this country.

All shipments of susceptible animals imported from Canada just prior to the closing of the border were traced and held under observation until it was determined that no infection had been brought into the country. In the meantime, the Canadian government adopted strong measures to wipe out the disease and confined the outbreak to a relatively small area of the Province of Saskatchewan. The last infection was found on April 28, 1952.

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## Garbage Cooking Legislation Defeated

The current epidemic of vesicular exanthema in swine was discussed by Dr. W. H. Shannon, at the annual meeting of the Massachusetts Veterinary Association on January 28, 1953. It was stressed that the disease is extremely widespread and has occasioned a great deal of financial loss to swine breeders in Massachusetts. The state is paying an indemnity when it becomes necessary to sacrifice swine as a control measure. It was revealed that legislation requiring the cooking of garbage fed to swine had been proposed and defeated. It was voted that the Association send to the governor a letter indicating that the cooking of garbage is an essential part of any program to control swine diseases; that the Association go on record as supporting this practice; and that the governor be urged to support any future legislation or regulations which might make this a required practice.

## Veterinarian of the Year

Dr. Wayne H. Riser, Skokie, Ill., practitioner specializing in small animal practice and executive secretary of the American Animal Hospital Association, was selected as Dog-

Dr. Wayne H. Riser, Skokie, Ill., (right), receives his "Fido" as Veterinarian of the Year, from Harry Miller at ceremonies at the New York Athletic Club.

dom's Veterinarian of the Year. Doctor Riser was cited for his scholarly papers presented at veterinary meetings as well as for his energetic efforts in behalf of the profession and dog-owners.

Selection of persons for various awards is by national poll of colleagues in special fields of activity. These are conducted annually by the Gaines Dog Research Center, 250 Park Avenue, New York 17, N. Y.

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## Humane Societies and Antivivisectionists

In a brief editorial comment, Capt. Will Judy (*Dog World*, January 1953) states that there appears to be a pointed demand of antivivisectionists that all humane societies accept their ideas of the use of animals for medical experiments. The situation is confused.

Most humane societies and workers are now in full accord with the use of animals under proper conditions for research into new methods and drugs that promise advantage in treating disease and saving lives.

Humane societies have lost financial support because of their straddling of some issues in the past. Unless these societies take a definite stand for medical progress, their activities are likely to be even more restricted because of lack of contributions.

# PRINCIPLES OF ANIMAL HEALTH

R. R. DYKSTRA, D.V.M.
Manhattan, Kansas

## Ovum Transplant

There is a good deal of discussion in the non-professional press about removing a fertilized ovum, the product of a high-producing cow and of a sire having an enviable record, to place it in the uterus of a scrub cow so that she may incubate the implanted ovum to fetal maturity. Theoretically, the original dam could then be fertilized frequently so that she could have several calves each year—at least so we gather from a perusal of the lay press. The practical difficulties in the way are: (1) It is extremely difficult to locate a fertilized ovum no larger than that of a month-old embryo in the uterus; in fact in all cases called to our attention, it has up to this time been found necessary to sacrifice the life of the dam. (2) The fertilized ovum once successfully removed from the original dam must then be implanted in the uterus of its prospective foster mother and this requires major surgery. There has been a hint that the original cow may be caused to have multiple ova following the use of gonadotropin, instead of the one she usually has, and that a single male ejaculate could fertilize all of these; however, let's not be too visionary.

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## Penicillin for Ovine Mastitis

Another inquirer wants to know about the handling of blue-bag (also called pink-bag or gangrenous mastitis in ewes). In our work, 500,000 units of penicillin administered intramuscularly in the early or pink stage of the infection usually results in its clearing up in three or four days. If gangrene has set in, surgical ablation is the approved step. Sanitation is quite essential in the handling of this ailment in the flock.

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Hyaluronidase, in isotonic sodium chloride solution administered hypodermically, according to a report in a medical journal, has been followed by a favorable response in clearing turbidity and sedimentation in urine and thus preventing the formation of calculi. It has proved to be of value in those patients otherwise subject to the rapid formation of kidney stones.

## Fat Substitutes in Ice Cream

"Creamless" ice-cream is now offered for sale in Illinois, Oklahoma, Texas and Missouri. Instead of cream, its principal ingredient is a vegetable oil such as cottonseed, soybean, peanut or coconut oil to replace the butterfat. It lacks certain vitamins, but can be fortified against this deficiency. It comes in a variety of flavors so that, to many people, it cannot be distinguished by taste from dairy ice-cream. It is much cheaper than butterfat ice-cream. Federal regulations do not permit interstate shipment of the artificial ice-cream.

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## Hypocalcemia in Dairy Cows

Hibbs, Pounden, and Krauss of the Ohio Agricultural Experiment Station, Wooster, gave a progress report regarding research work on the problem of milk fever in dairy cows. They worked with 18 cows, divided into groups of nine each so that one of the two groups would serve as controls. Beginning eight weeks before the due date and continuing for one week postpartum, all of the cows were given daily 6 lb. of steamed bone meal, and in addition, one group of nine cows received daily 5,000,000 units of vitamin D for two weeks prepartum and three days postpartum. Four of the vitamin-D-fed cows developed milk fever and three of the control group. The results are considered to be evidence that the failure of the blood calcium may be due to some fault in the blood-calcium regulatory mechanism, probably in the parathyroids. An interesting observation of these researchers was that milk fever cows secrete no more colostrum, nor does it contain more calcium, than that of normally freshening cows. The investigators at Ohio plan to continue their work in this field.

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The Brucellosis and Tuberculosis Division of the U. S. Bureau of Animal Industry reports that during the last fiscal year 9,164,265 cattle were tested for tuberculosis, and that 0.11% reacted positively to the test. This is said to be the lowest percentage of record.

# POULTRY PRACTICE PROBLEMS

W. R. HINSHAW, D.V.M., Ph.D.
Frederick, Maryland

## The Bursa of Fabricius

The bursa of Fabricius of fowls is an organ found only in young birds. It is epithelial in origin and in its active stages is composed of lymphoid tissue. It is a pouch-like organ which opens into the dorsal cloacal wall. In young chickens from four to five months of age it attains a size of 2 to 3 x 1.5 cm., but by ten months has nearly disappeared. Its function is not understood. In birds suffering from vitamin A deficiency, a whitish-yellow caseous exudate collects in the bursa. This is particularly true in turkeys. A fluke, *Prosthogonimus macrorchis*, occurs in the bursa of Fabricius and oviduct of the duck, chicken, and other birds in the United States, especially in the lake regions of Minnesota and Michigan. In young turkeys which have recovered from hexamitiasis, but remain carriers, *Hexamita meleagridis* localizes in the bursa until it disappears after puberty. The organ is recommended by Gibbs (Mass. Agr. Exp. Sta. Bull. no. 311, 1933) and Beach *et al.* (*Poultry Sci.*, 57:133, 1935) as a desirable site for injecting vaccine for control of infectious laryngotracheitis. A description of the bursa is published by Calhoun (*Jour. Sci.*, 7:261, 1933).

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Newcastle disease may not be the most satisfactory name for this nervous-respiratory disease of fowls, but it is so well established in the literature that it should be universally adopted as the standard name. The only one of the other numerous synonyms that have been previously used which still creeps into publications is avian pneumoencephalitis, and in these instances it is usually in publications from California where the name originated when it was thought the disease discovered there was different from the one described by Doyle in 1927 and in 1935 named Newcastle disease by him (*Jour. Comp. Path.*, 40:144, 1927 and *Jour. Comp. Path.*, 48:1, 1935). Since it is now definitely established that these diseases are identical, it is foolish to confuse bibliographies any longer with two names for the same disease. It is suggested that committees on standardization of nomenclatures and editors of veterinary journals cooperate in eliminating the confusion which still exists concerning the correct name for the disease by adoption of the name, Newcastle disease, because of its general acceptance over a long period of time.

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Hybrid chicks can be called "hybrids" only if they meet qualifications set forth by the Federal Trade Commission. The term can only be used to describe chickens which are "incrossbred". An incrossbred is the first generation baby chick produced by a combinational crossing of two, three, or four inbred lines of different breeds or varieties. Chicks which result from crossing inbred lines of the same variety or breed may be called "incross" according to the Commission (*A.P.H.F. Hatchery Letter*, July 22, 1952).

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An incubator temperature above normal or optimum causes high mortality especially during the last week of incubation, according to Insko (Fertility and Hatchability of Chicken and Turkey Eggs by Taylor, N. Y., John Wiley & Sons, 1949, p. 210). This occurs on the 19th day for chicken eggs and on the 25th day for turkey eggs. The extent of mortality is dependent upon the period of maintenance of the increased temperature and number of degrees it is increased.

For example, in forced draft types of incubators used for hatching chicken eggs, the recommended temperature varies from 99 F. to 100 F. In one type of forced draft incubator, Barott (USDA Tech. Bul. 553) found that best hatches were obtained with a temperature of 100 F. Hatchability in this incubator was decreased at both higher and lower than this optimum temperature, and at 96 F. and 103.5 F. nearly all the embryos died. The optimum temperature for each species is dependent upon type and manufacture of the incubator. For these reasons, it is very important that the recommendations of the manufacturer be followed to ensure maximum livability and hatchability of both chicks and poults.

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An important cause of the development of white feathers in the wings of turkey poults is a deficiency of lysine in the ration.

# VETERINARY PARASITOLOGY

A. O. FOSTER, B.A., M.A., Sc.D.
Beltsville, Maryland

## Atypical Lungworm Disease of Cattle

Researches now being pursued in England on the thread lungworm, *Dictyocaulus viviparus*, deserve the attention of veterinarians wherever cattle are raised. This work has been the subject of earlier comment on these pages,[1] but later studies [2,3] have brought to light new information on the nature, occurrence, diagnosis, and importance of the infestation.

The most significant aspect of the latest studies is the recognition of acute atypical disease in adult cattle. According to the usual concept, lungworm disease mainly affects young stock, is rarely severe in adult animals, and is commonly a mild, somewhat chronic, condition that is suspected when there is a characteristic, husky coughing by a few individuals in a herd that is doing poorly. Symptoms are suggestive of chronic bronchitis. In the more severe cases affecting calves, there are paroxysms of coughing, dyspnea, and prostration, with intervening spells of weakness, shallow breathing, and respiratory embarrassment. Death may come from pneumonia, suffocation, or exhaustion. The diagnosis of clinical cases, moreover, is supported by demonstrating lungworm larvae in the feces. The British workers observed this typical form of the disease "on 22 occasions during 1948 to 1950". However, lungworm larvae were demonstrable in the feces of only a few of the affected animals.

In the atypical disease, asthmatic breathing with open mouth and protruded tongue appears suddenly in adult cattle, while young stock and calves of the same herd are in apparently good condition. There is cough and temperature suggestive of pneumonia. Auscultation of the chest suggests extensive bilateral emphysema. Abortion may occur, probably brought on by anoxemia and labored breathing. Finally, some animals may die within two weeks of the onset of symptoms. These events occur during the prepatent period and may be a kind of allergic reaction. After the first symptoms appear, periods up to 20 days may elapse before larvae are detected in the feces. In animals that die, variable numbers of sexually immature worms are found in the bronchi and bronchioles. Meanwhile, younger stock of an affected herd may begin to manifest symptoms of typical lungworm disease with discharge of larvae in the feces.

The concept of "carriers" is given substantial support. Circumstances suggest that animals of some herds in which no lungworm disease has been apparent may cause outbreaks among healthy herds into which they are introduced. Heretofore, the infestation has been regarded as self-limiting, with a prepatent period of about four weeks followed by a patency of about eight weeks, and this is the biological basis of effective control by good nursing care. The present studies, moreover, confirm earlier work of Porter and Cauthen[4] on numerous aspects of lungworm disease, including the short duration of pasture infestation. Infective larvae survived as long as four weeks but less than 1% appeared to persist after two weeks.

It will be recalled that Porter, Graham, Baker, Mayhew and others before them have emphasized the pathogenicity of bovine lungworms in the United States, and that they as well as earlier British workers (McCunn, Roberts, Smythe, Taylor *et al.*) noted occurrence of the disease in mature animals. The recent studies, however, show that the condition in these animals is more serious and probably more common than heretofore supposed, that grave disease may be precipitated by comparatively mild exposure, and that diagnosis can rarely be made by finding the characteristic larvae in the feces.

Fortunately, even the severest disease in adult stock usually responds rapidly to prompt nursing care and good feed. There is no specific treatment, and resort to inhalations and intratracheal injections should be discouraged. Adjuvant therapy against secondary infection is, however, helpful, as is proper medication against enteric parasitism.

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Experimental work has shown that the carcass grades of estrogen-treated lambs tend to be inferior to those of controls.

[1] *Vet. Med.*, 47:38, 299, 1952.
[2] *Vet. Rec.*, 64:589, 1952.
[3] *Brit. Vet. Jour.*, 108:204, 1952.
[4] *Am. Jour. Vet. Res.*, 3:395, 1942.

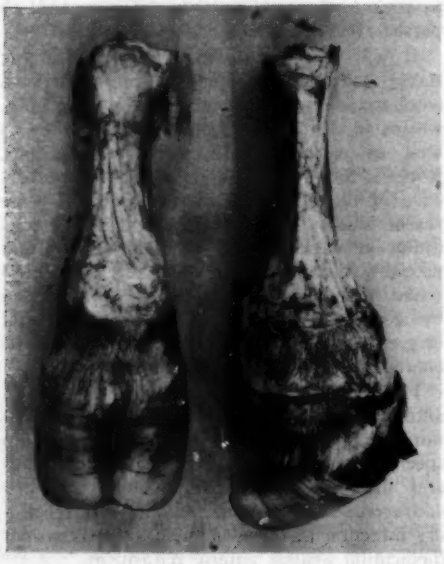
## "Fescue-Foot" or Ergotism in Kentucky*

ROSS BROWN, D.V.M., Lexington, Kentucky

Four cases of so-called fescue-foot have been reported to the Department of Animal Pathology of the Kentucky Agricultural Experiment Station. Two of these were beef cows presented on December 15, 1952. The owner planned to take these animals to slaughter but brought them by for us to see.

These cows were two of 30 head turned on Kentucky 31 fescue pasture after a seed crop had been harvested about the middle of October. They received no other feed while on this pasture.

After about three weeks, one cow began limping. The local veterinarian treated for foot-rot, but the animal failed to respond. Meanwhile two others developed lamenesses. All were taken off the fescue pasture about the middle of November. Thereafter, one recovered but two others worsened. These were the two brought to the Department of Animal Pathology for examination. Both exhibited typical ergot lesions—one on one rear foot above the coronary band, the other in both rear feet.



Members of this department and of the Department of Agronomy examined the fescue pasture for ergot, but it had been grazed so closely that, if present, ergot was no longer possible to detect.

The lesions shown in the accompanying pictures are typical of ergot poisoning and likely were caused by ergot or similar fungus. There is absence of conclusive proof. Ergot is a fungus that develops on a great number of grasses and grains, and not on fescue alone.

*From the Department of Animal Pathology, Kentucky Agricultural Experiment Station, Lexington.

The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the director.

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## Intestinal Invagination

J. E. CURRY, Springfield, Illinois

A five-year-old, 1,000 lb. Hereford stock cow was presented to the Kansas State College Veterinary Clinic. History given by the owner was incomplete but included the following: The cow had calved two weeks previously and had cleaned properly. Both cow and calf had made favorable progress until four days earlier. At this time the owner noticed that the cow was off feed, was restless, and exhibited some

colicky pains. There had been no attempts to treat the animal. The patient had been trucked some 50 miles to the clinic.

When presented for examination the cow was in the sternal rest position. Clinical observation revealed: depression with no evidence of colicky pains; temperature 100.5 F., extremities cold; pulse fast but weak (110 per minute); respiration shallow and irregular (30 per minute); peristalsis totally suppressed accompanied by mild bloat; mucous membranes injected, slightly congested, and bluish-red; no evidence of recent defecation; rectum empty but coated with a sticky, black, mucilaginous substance and the small intestine distended with gas. Although no hard mass could be palpated rectally a diagnosis of intussusception was given.

During the process of the examination the animal shifted from its sternal position and came to rest on its right side. Breathing became irregular and the limbs were extended. The condition degressed rapidly and the animal died within 30 minutes.

Postmortem examination substantiated the diagnosis. There was a ten-inch invagination of the small intestine. There was no peritonitis or ruptured viscera. The cause of death was presumed to be from acute intoxication caused by the trapped ingesta.

Cases of intussusception are rather rare. When discovered early, most cases can be effectively treated by laporotomy, resection of the affected parts, and anastomosis according to the technic described by Kerr and Parker.

The condition is rather easily diagnosed by the cessation of fecal evacuations and the rather characteristic sticky, black, mucilaginous substance on the wall of the rectum.

The exact etiology is unknown, but is explained as an irregular peristalsis whereby a portion of intestine under contraction slips into and is overlapped by a relaxed portion of the intestinal wall. The result is occlusion and hyperemia progressing to necrosis.

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## Lactation After Abortion in Dairy Cows

Dairy cows fail to come in full lactation after abortion. Estrogen treatment, suggested by Dr. C. W. Turner, should be initiated immediately and continued for seven to ten days, then stopped abruptly. Diethylstilbestrol at the rate of 10 mg. daily is recommended.

## Foreign Body in Cat's Tongue

R. H. GUMP, D.V.M., Wichita, Kansas

The accompanying reproduction of an *x*-ray showing a sewing needle embedded in a cat's tongue depicts a rather common occurrence. The unusual factor in this particular case is the

direction of penetration; the needle entered near the base of the tongue and apparently progressed in an upward and forward direction. An eight-inch length of thread was attached. No difficulty was experienced in removal after the patient was anesthetized.

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## Dislocation of the Shoulder in a Cow

GEORGE A. PIPER, D.V.M., Viroqua, Wisconsin

A young Jersey cow was examined for lameness of the left front leg. The animal was severely affected; the foot was held off the ground. Swelling was noted about the point of the shoulder. Upon examination, it was concluded that the scapulohumeral articulation was dislocated or fractured. There was no crepitation evident on manipulation though movement caused extreme pain.

The leg was extended upward and forward as far as possible at which time the joint slipped back into place. The leg was placed in its normal position; the animal put weight on it immediately. The owner was instructed to continue confinement of the animal in the box stall for further observation. No complications developed and complete recovery ensued. The cow was returned to pasture after a rather lengthy rest. No medication was administered at any time.

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The day of the horse is not passed. Many people turn to horses for recreation and pleasure.—*S. G. Graff, D.V.M.*

# BOOK REVIEWS

*Books reviewed in this department and any other books, if available, may be obtained by remitting the published price to the Book Department, Veterinary Medicine, Suite 803 Livestock Exchange Building, Kansas City 2, Missouri.*

**FUNDAMENTALS OF THE HISTOLOGY OF DOMESTIC ANIMALS** by *Dr. med. vet. Alfred Trautmann*, professor, Hannover, Germany, and *Dr. med. and dipl. vet. Josef Fiebiger*, professor, Vienna, Austria. Translated and revised from the 8th and 9th German edition, 1949, by *Robert E. Habel*, D.V.M., associate professor of anatomy, New York State Veterinary College, Cornell University, and *Ernst L. Biberstein*, D.V.M. 426 pages, 449 illustrations, many in color. Comstock Publishing Associates, Ithaca, N. Y., publishers, 1952. Price $8.75

Competently translated and modified for American use, this standard German work is the first veterinary histology text made available for students and practitioners. The histologies of the horse, ox, pig, goat, dog, cat, and chicken are covered. Important differences are stressed and emphasis placed on their relation to physiology and pathology.

The book escapes much of the detail that is so confusing to the beginning student.

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**LIGAMENT INJURIES OF THE CANINE STIFLE JOINT.** A clinical and experimental study by *Saki Paatsama*, Royal Veterinary College, Stockholm. A thesis (translation). 82 pages, 31 illustrations, 9 tables. Kauppakirjapaino O. Y., Helsinki, publishers. 1952. Price not quoted.

The internal derangements of the canine stifle joint have considerable clinical and practical importance. Although surgical intervention has made considerable progress, there has been a lag in experimental investigation into ligament injury as related to osteoarthritis. Likewise, there has been little previous mention of therapy in literature.

The work is not a superficial one. It concerns 242 observed cases, 43 of which were operated by the author. The work is constructive, concise without being exhaustive. Its completeness should gain favorable comment from practitioners.

The thesis presents a complete tabulation of breed, cause, and age incidence, as well as a description of the type of injury. A comprehensive introduction considers the internal derangements of the joint, osteoarthritis, surgical landmarks, physiological factors, and symptoms.

The results of surgically produced lesions are presented in a later chapter. The clinical picture of the live animal is presented.

Surgical intervention, technics of transplantation, and plastic operations on the collateral and cruciate ligaments are also presented in a later section.

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**THE ANATOMY OF THE DOMESTIC ANIMALS.** A text and reference, by *S. Sisson*, S.B., V.S., D.V.Sc., late professor of comparative anatomy, Ohio State University, Columbus; revised by J. D. Grossman, G.Ph., D.V.M., professor of veterinary anatomy, Columbus, Ohio. 972 pages, 738 figures, many in color. New 4th edition. W. B. Saunders Co., Philadelphia and London, publishers, 1953. Price $15.

An authoritative text long familiar to veterinary students and practitioners, this thoroughly revised edition retains all of the virtues of the older volume, plus more recent investigations and experiences in the field of anatomy. Profusely illustrated, clearly worded, it remains a leader in its field.

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**TIERAERZTLICHE LEBENSMITTELUEBERWACHUNG** (Veterinary Food Inspection), by *Dr. G. Wundram* and *Prof. Dr. F. Schoenberg*, Veterinary College, Hannover. 6th edition. 420 pages, 222 illustrations. Verlag Paul Parey, Berlin SW 68, publishers, 1953. Price DM 43.

This German standard text on veterinary food inspection deserves high commendation for the excellence of the illustrations and the systematic treatment of the subject. The authors present in integrated form a vast amount of data on the properties and behavior of meat, whale, fish, poultry, game, and eggs. They describe foods, food processing and conservation, with copious reference to the German veterinary inspection and food laws, literary sources, and court cases.

# THERE'S NO SUBSTITUTE FOR EXPERIENCE . . .

***Raleigh Hough*** was "born and raised" in the cattle business. So the decisions he must make on the T-Box Ranch near Ft. Morgan, Colorado, are tempered with his years of experience.

From that experience, Mr. Hough has learned what factors contribute to the success of a cattleman.

He depends on his veterinarian to keep disease and injury losses to a minimum. He's found feeding and management knowledge from Purina sound and helpful. And he knows he can depend on Purina Chows to help meet the nutritional needs of his cattle.

**RALSTON PURINA COMPANY**

St. Louis 2, Missouri

**HEALTH and NUTRITION go hand in hand**

# ITEMS OF VETERINARY INTEREST

Treatment for "greasy" pigs: Dip affected pigs in 2% pine oil solution. *J. D. Ray, D.V.M.*

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Baby pigs have been raised successfully from two or three days of age in concrete runs, on synthetic milk rations, lard, essential minerals, vitamins, and antibiotics.

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Four important diseases of cattle must be considered in determining the cause of abortion storms. They are brucellosis, leptospirosis, vibriosis, and trichomoniasis.—*W. L. Boyd, D.V.M.*

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Dogs now consume $200,000,000. worth of dog food annually and use an additional $300,000,000. worth of clothing, shelter, training, and medical care.—*Feeding Forum.*

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Abscesses in the human uterus and vagina may be the result of ascariasis. These nematodes may also enter the urinary bladder and urethra of the male.

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The advantages of the all-mash system of chick feeding are improved growth and grains in relatively poor chicks, resulting in lower mortality, fewer culls, higher and more uniform egg production, drier litter, and more uniform egg quality.—*Poultry Digest, March 1953.*

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More than 80% of all cattle, calves, sheep, and swine slaughtered commercially during 1951 were slaughtered under the supervision of the federal meat inspection service. At the close of 1952, inspection was carried out in 1,012 plants located in 401 cities and towns. —*Natl. Prov., Feb. 14, 1953.*

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The most important of the blood-sucking bats makes a shallow, clean-cut groove in the skin of his victim, with his enlarged incisor teeth. To do this he waits until his host falls asleep, then delicately makes his furrow in the flesh. The wound bleeds freely and the bat feeds. *Vampyrus spectrum*, the vampire bat, hardly deserves his reputation. He is largely a harmless fruit-eater.

Turkey producers expect to reduce production by 8% this year. Past experience has shown that such predictions do not always materialize.

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Research has established that leptospirosis causes abortion. Why these animals abort is not explained. Organisms are not demonstrated in fetus or placenta.

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Twinning percentage in ewes has been increased in trials conducted in New Zealand. One dose of 500 to 1,000 I.U. of pregnant mares serum (P.M.S.) is administered 12 to 14 days after estrum and the ewes bred on the following heat period.—*C. W. Turner, Ph.D.*

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The Department of Dairy Husbandry, Kansas State College, reports 64% artificial breeding efficiency in 3,545 first services in November 1952, and 69% efficiency in 6,046 cows on the first services in December.

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If you are interested in classification of feathering in broiler stock, there is a new bulletin on this subject available from Kansas State Agricultural Experiment Station (Kans. Agric. Exp. Sta. Tech. Bul. 72, June, 1952).

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Concentrated lye is a poison and is destructive to aluminum, paints, and clothing. In the dilute concentrations it does not harm wood or iron, nor is it harmful to animals. It should not be allowed to collect in places where animals can drink it. One can of lye, 13 ounces, is enough to make 15 gallons of cleaning and disinfecting solution.—*USDA, F. B. 2050.*

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Resistance to parasites is often proportional to age. Young hosts are therefore often resistant in a greater or less degree. True age resistance results only when the animal itself has built the resistance. Passive resistance acquired through the mother is not true age resistance.

An explanation for this resistance is perhaps found in the fact that young are not fully developed and cannot put forth full resistance. This does not explain reversals in age resistance where the young become increasingly susceptible with age.

# Florida State Veterinary Medical Association Meeting

On this and the following pages is presented most of the literary program of the 23rd annual meeting of the Florida State Veterinary Medical Association. Discussions are presented so far as practicable. Some of the discussions were illustrated with moving pictures, lantern slides, or charts which, while adding to the interest and information of those fortunate enough to be present at the sessions, do not lend themselves to reproduction here. Not all material presented is included, either because of the nature of the discussion or for other reasons.

Dr. Robert P. Knowles, Secretary-Treasurer

Dr. Ronald F. Jackson, President

Veterinarians assembled at the George Washington Hotel, West Palm Beach, on October 26, 1952, to attend what might be considered as a preconvention session on Sunday afternoon. Actually, the program, arranged for that day by Chairman C. E. Bild, Miami, was an integral part of the annual meeting. It has been the custom of the Association in recent years to devote the Sunday afternoon preceding the formal meeting to short discussions, demonstrations, and clinical briefs. This year's session was handled masterfully by Doctor Bild. Each speaker was allowed a set number of minutes, usually five minutes, in which to discuss the subject assigned or to demonstrate a specialty, with time being called to keep the program on schedule for four hours. Twenty-nine speakers, most of them Florida practitioners, appeared at this single session which was unbroken except for a brief intermission. Notes taken are assembled under the general heading of Clinical Tips and Demonstrations.

Facts, figures, and fellowships was the general theme of this meeting, characterized by free exchange among all present. It is singularly remarkable that a total of 32 members of the Association took an active part on this program. In this was typified a fine spirit of cooperation among practitioners of the state in which all may take justifiable pride.

The South Florida Veterinary Society entertained speakers and other guests at Miami during the week-end preceding the state meeting. These social features, as well as those arranged during the meeting at West Palm Beach, were extraordinarily elaborate and pleasurable.

Dr. C. E. Dee, Hollywood, presided at this meeting as president. He was succeeded by Dr. Ronald F. Jackson, St. Augustine. Dr. Robert P. Knowles, Miami, was re-elected as secretary-treasurer.

### President's Address

In his address at the first formal session, Dr. C. E. Dee spoke of two primary issues of concern to Florida practitioners. He considered public relations of the profession and establishment of diagnostic laboratory facilities to assist practitioners in rendering an improved

service to the rapidly expanding livestock industry in Florida and to the public.

These recommendations are considered to be forward and aggressive veterinary medicine, particularly since current problems existing in Florida are not common to all sections of the United States. Confirmation was given to the general plan of organization, under supervision of the State Livestock Sanitary Board, and location for convenience of practitioners.

It was visualized that the contemplated diagnostic laboratory would function in a manner such as outlined by Dr. W. L. Sippel, Tifton, Ga., in charge of veterinary research at the Georgia Coastal Plains Experiment Station. A diagnostic facility can be used to investigate individual specimens submitted and also serve as an information center. Veterinarians may thus be alerted to outbreaks of new diseases or increased incidence of old ones, whether the spread be wide or limited. A regular news sheet was suggested that could be of inestimable value. The offer of telephone consultation service might also assist because of access to more complete library references and research information. The center might be employed as a news distributing center for release of bulletins of interest to livestock growers. Such service would do double duty as a public relations effort and to solicit wide support and cooperation in disease control. Certainly it is not intended or necessary that this type of laboratory engage in basic research.

Dr. C. E. Dee (left), Hollywood, outgoing president of the Florida State Veterinary Medical Association, discusses a program item with Dr. C. D. Van Houweling (center), assistant executive secretary of the A.V.M.A., and Dr. Stanley C. Wasman, Miami Beach, president of the South Florida Veterinary Society.

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Hastily dispensed empiricals following uncritical diagnoses probably do more to force clients to injudicious home medication than any other combination of factors.

Guest speakers at the Florida State Veterinary Medical Association meeting. Bottom row: (l. to r.) Frantisek Kral, Philadelphia, Pa.; C. E. DeCamp, New York City, N. Y., David L. Coffin, Boston, Mass.; Francis T. Candlin, Denver, Colo. Standing: (l. to r.) W. L. Sippel, Tifton, Ga.; S. F. Scheidy, Philadelphia, Pa.; J. V. Lacroix, Evanston, Ill.; C. D. Van Houweling, Chicago, Ill.